An Argus Specialist Publication

JULY 1985

90p

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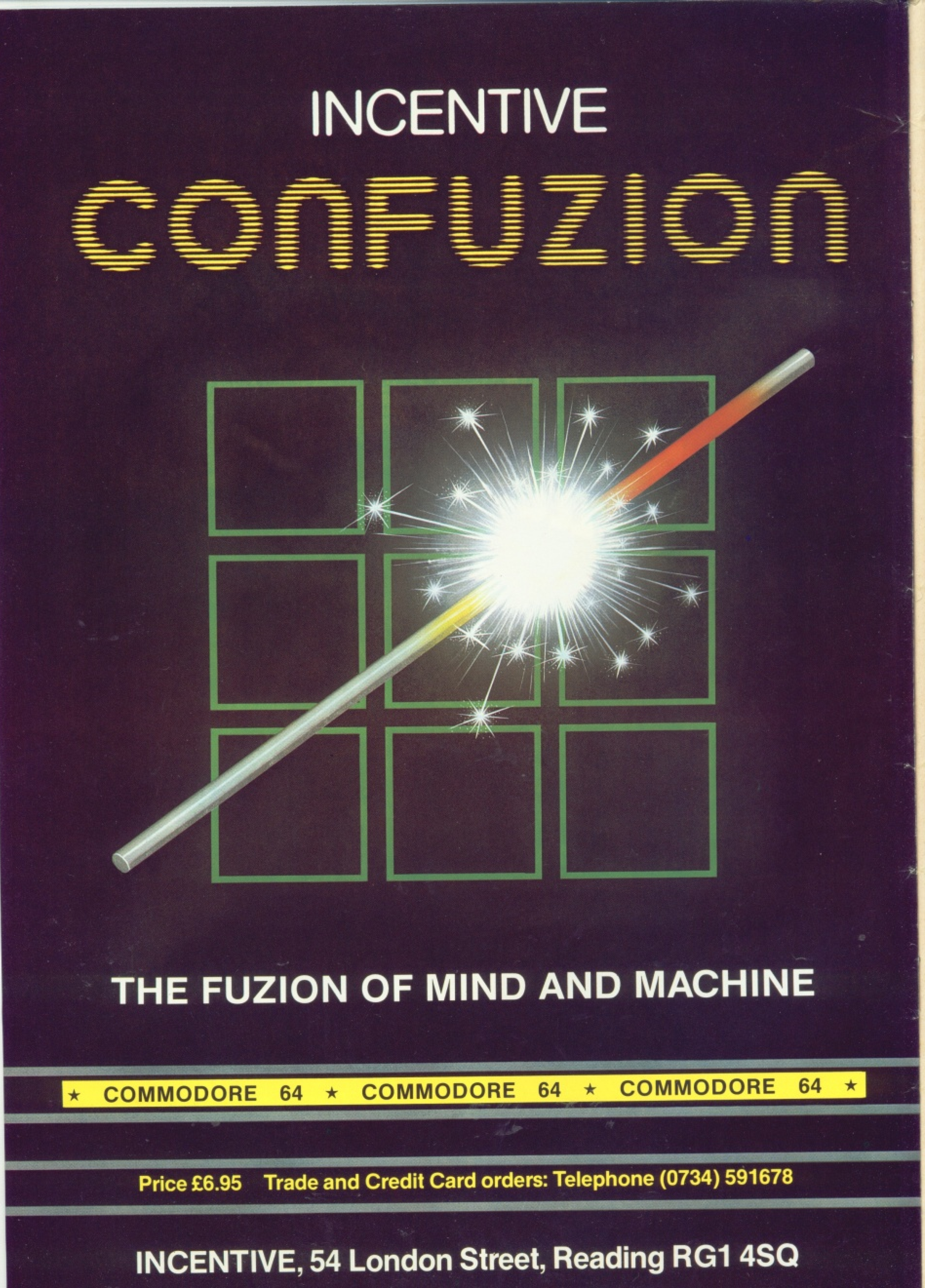


Flight simulators – the plane truth

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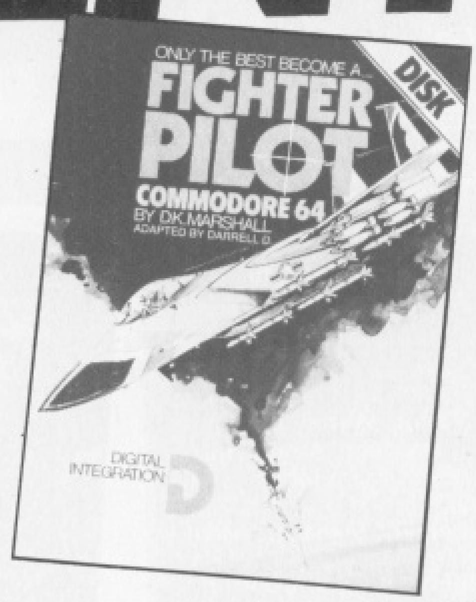
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Our COMMENT





PICTURE IT. ANOTHER SLEEPY AFTER-noon in the heart of suburbia. In a living room resplendent with rich furnishings and potted plants, a blade of sunlight cuts through a gap in the drawn curtains, directed at Adenoid Anthony as he sits before the TV screen, Commodore 64 at his knees, discarded software to his left and joystick firmly clasped in his right hand.

It's teatime and Anthony's tastes are changing. Green things from outer space are as stale as old cake crumbs, platforms and ladders have met the same fate as used tea bags and most adventures offer as many thrills and spills as watching the milk curdle in Auntie Elsie's Royal Wedding souvenir milk jug. No pretty graphics scroll before Anthony's eyes, no revamped pop songs rock his ear drums. In their place, stretches a mass of instruments, dials and switches – a realistic interpretation (depending on which simulator Anthony has loaded into his 64) of the instrument panel of a real, live aeroplane. In fact, it is so realistic that Anthony is quite oblivious to Rover as he ravages the last remaining pirated copy of Raid Over Moscow (... the one for which, in true Le Carré style, he'd hoped to extort vast sums of money from little Igor Bogolovich at the Embassy school).

The engine rumbles, the speed and Anthony's adrenalin rise in unison and the altimeter needle swings gradually to the right as the plane leaves the runway, shooting into the wild blue yonder over a patchwork of rapidly shrinking terrain.

Anthony's concentration is momentarily diverted as the shapely stewardess steps tentatively into the cockpit; 'tis mum with a lukewarm cup of tea. But, our intrepid pilot keeps his cool and the plane remains on course.

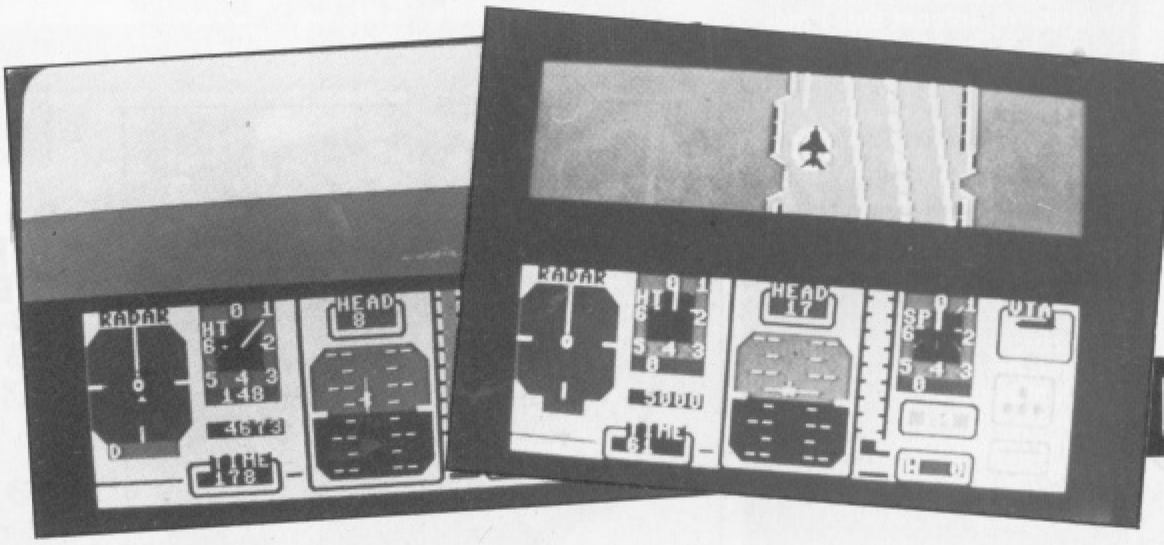
Not for long. As with all good air disaster movies (are there any good air disaster movies?), the hi-jacker enters the scene. This one's a right smart alec. Not only is he trying to show the pilot who's boss, but he even wants to have a go at the controls himself. "Looks like a good wheeze, Anthony; reminds me of my days in the RAF". "No old war stories now, dad; I must concentrate". "Just a quick go ...". When I've finished ...". "Now look here, son; who bought you that computer anyway?". What can our hero do in the face of such adversity? Nothing. Force prevails and, with control in the hands of His Bossiness, before you can say 'bombs away', the screen flashes and the plane crashes. The dream is broken.

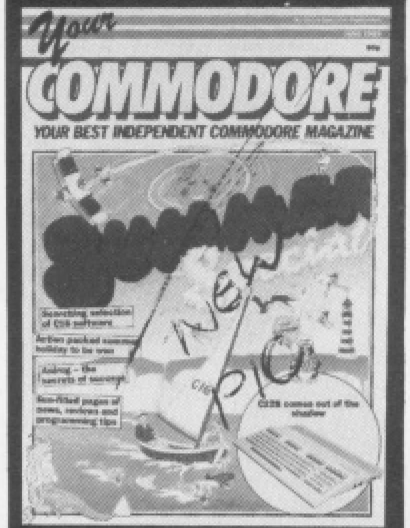
'Has the editor flipped her lid?', I hear you ask. We know that prolonged exposure to typewriters has been known to be ruinous to one's health, but we hope the poor dear realises she is producing a computer magazine and not a toss-up between a flight manual and a book at bedtime.

Fear not, dear readers. Your Commodore has merely caught a spot of Biggles fever this month (must be the effect of all those VE day celebrations). And this is all a rather convoluted way of inviting our readers on board for a journey through an assortment of flight simulators available for the 64. These cover a very broad spectrum of planes from gliders and helicopters to 747 airliners and spitfires.

Having got off to a flying start with our reviews, we hope to take you one step further with our air-raising competition – a chance to win not only Anirog's Super Sketch but also one of 50 copies of the newest of the new flight simulators, Jump Jet, which promises to be an excellent follow-up to Anirog's already ultra-successful Flight Path 737. Jump Jet even contains speech, something which any self-respecting computer program should own nowadays. What more could an aspiring pilot ask for?

Over and out.





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JULY 1985

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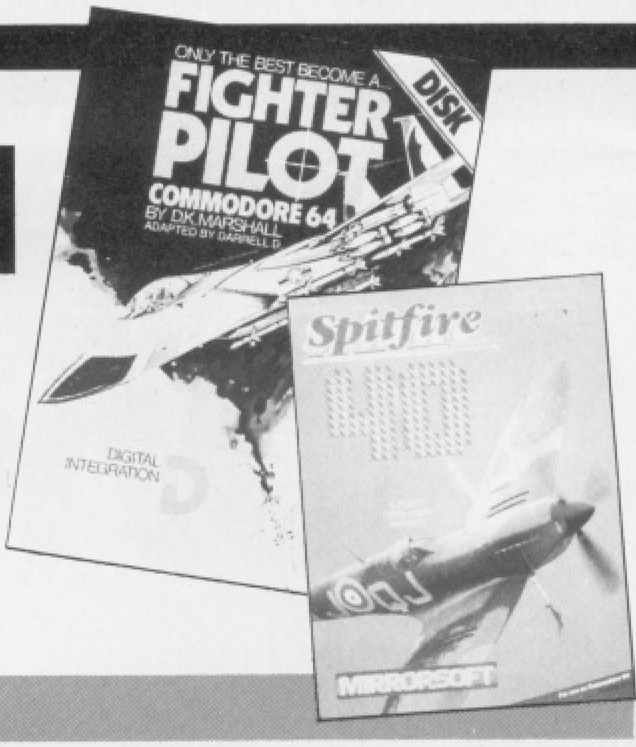
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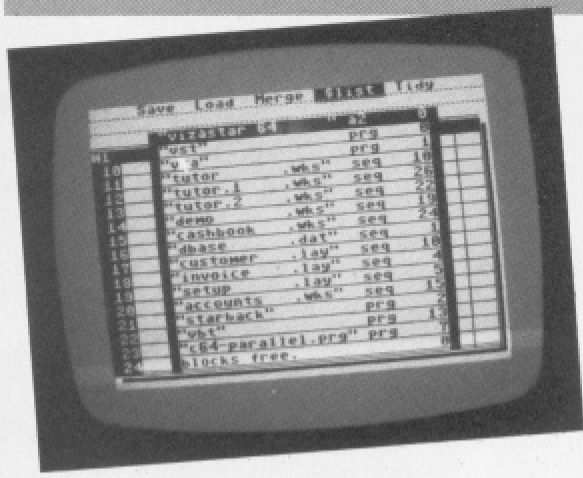
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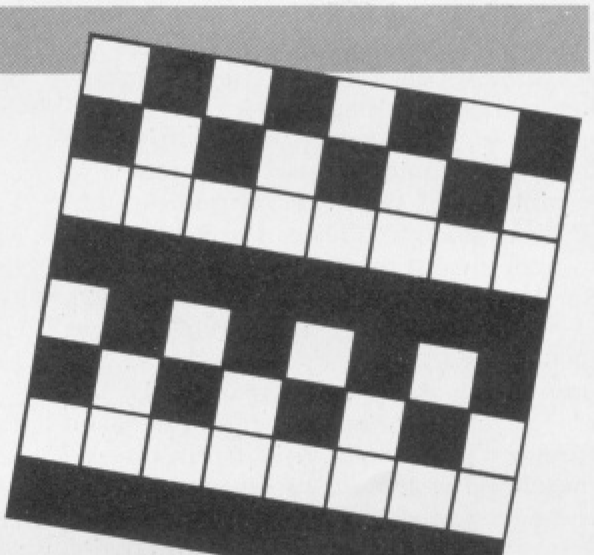
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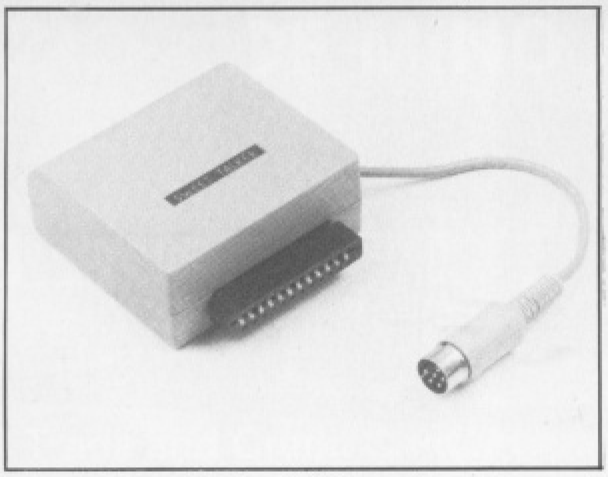
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FEATURES









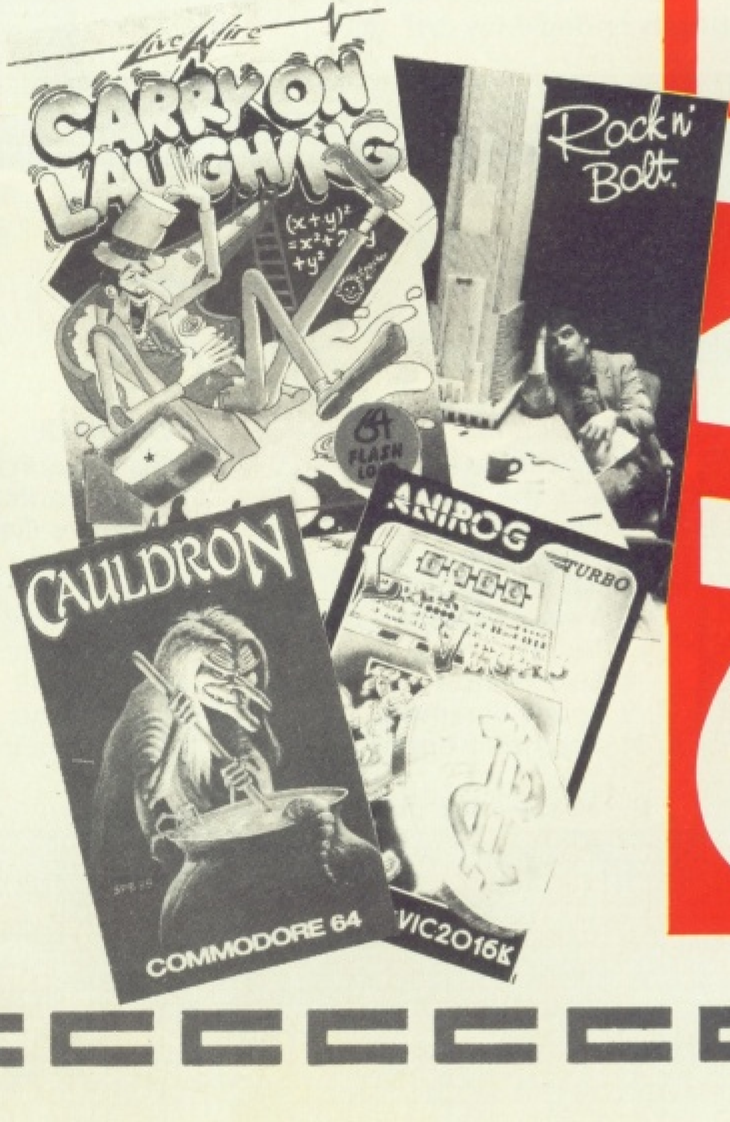
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SERIES

GAMES AND UTILITIES

REGULARS



TOP 20 Software

Compiled by Gallup



COMMODORE 64

	TITLE	PUBLISHER
1	Soft Aid	Various
2	World Series Baseball	Imagine
3	Impossible Mission	CBS
4	Brian Jacks' Superstar Chal.	Martech
5	Air Wolf	Elite
6	Pole Position	Atari
7	Rocket Ball	IJK Software
8	Ghostbusters	Activision
9	Gremlins	Adventure International
10	Bruce Lee	US Gold
11	Zaxxon	US Gold
12	Daley Thompson's Decathlon	Ocean
13	Raid on Bungeling Bay	Ariola Software
14	Pitstop 2	CBS
15	Raid Over Moscow	US Gold
16	Football Manager	Addictive
17	Spy Hunter	US Gold
18	Hunchback at the Olympics	Ocean
19	Spooks	Mastertronic
20	Breakdance	CBS

Retail sales for the month ended May 3rd 1985.

VIC 20

Top Ten

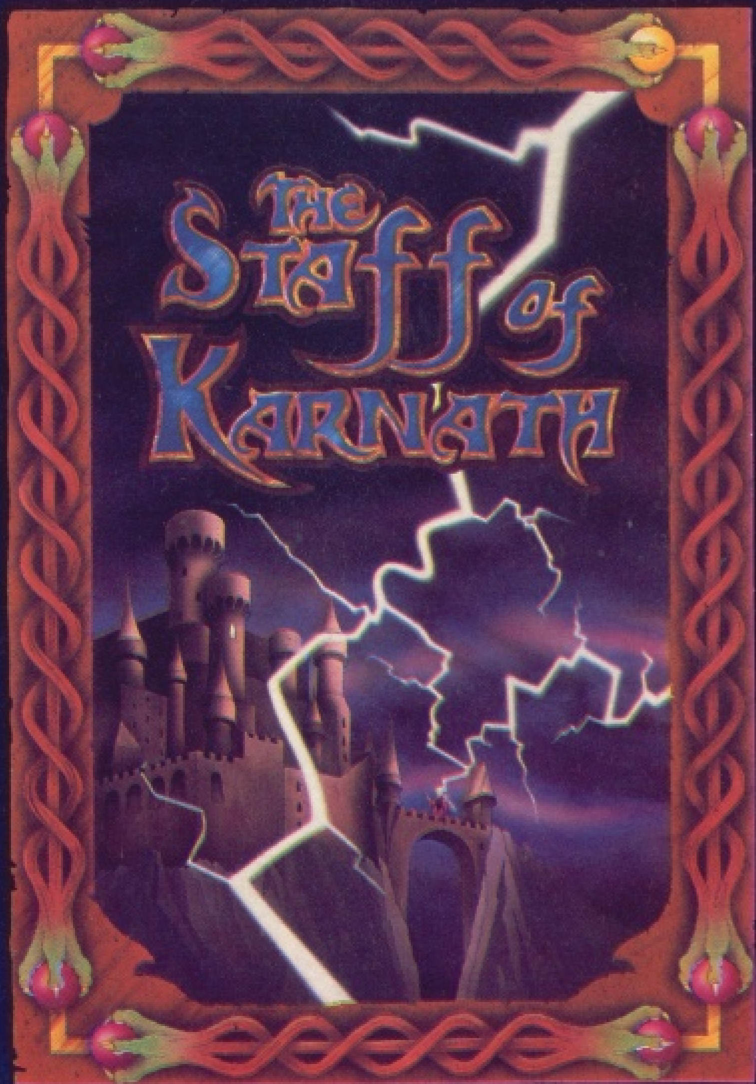
	TITLE	PUBLISHER
1	Rockman	Mastertronic
2	Rip the Game	Mastertronic
3	Football Manager	Addictive Games
4	Hunchback	Ocean
5	Micky the Bricky	Firebird
6	Vegas Jackpot	Mastertronic
7	Bullet	Mastertronic
8	Sub Hunter	Mastertronic
9	Space Scramble	Mastertronic
10	Psycho Shopper	Mastertronic

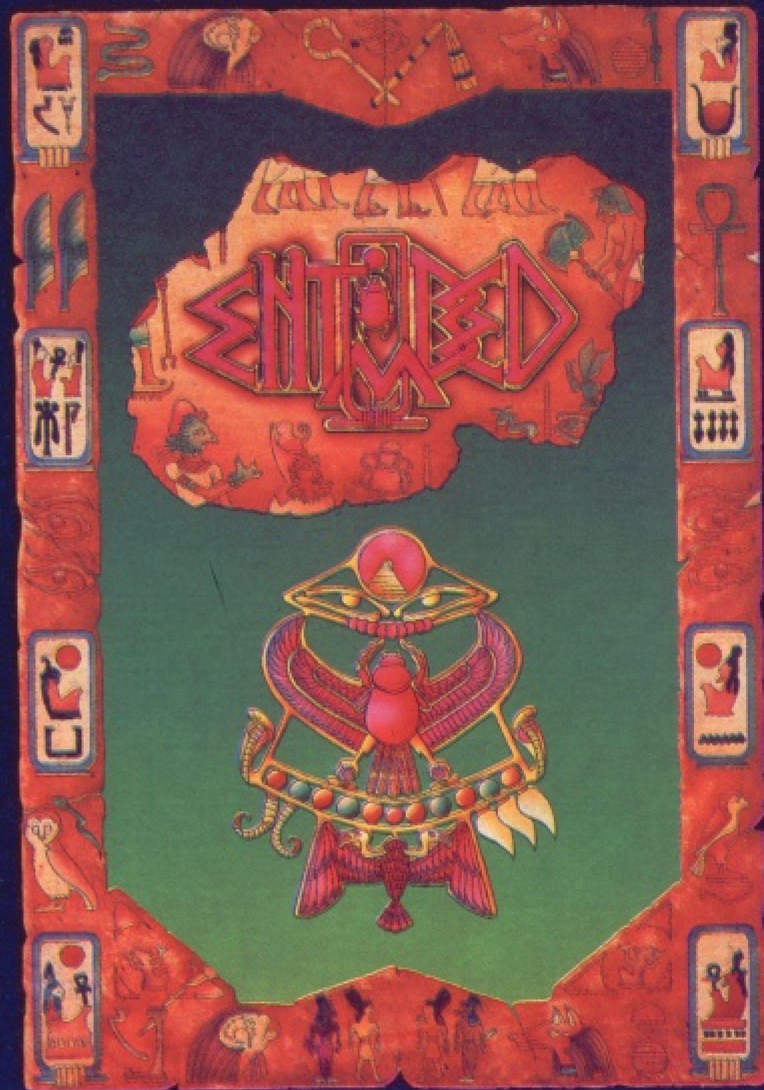
Retail sales for the month ended May 3rd 1985.

Compiled by Gallup for the industry's weekly trade magazine, Computer and Software Retailing. For details contact John Ross, Computer and Software Retailing, 222 Regent Street, London W1R 3AB. 01-434 2131.

ULTIMATE PLAY THE GAME

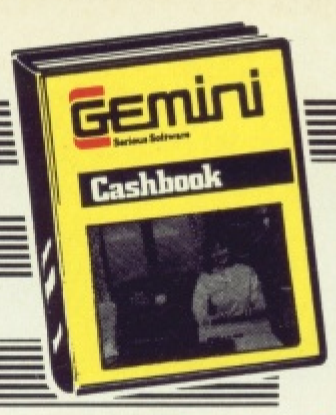
COMMODORE 64





"STAFF OF KARNATH" and "ENTOMBED" recommended retail price £9.95 inc VAT. Available from W.H.SMITHS, BOOTS, J.MENZIES, WOOLWORTHS and all good software retail outlets. Also available from ULTIMATE PLAY THE GAME, The Green, Ashby-de-la-Zouch, Leicestershire LE6 5JU (P&P are included) Tel: 0530 411485

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C.0818 — Cassette — **£89.95**
D.0818 — Disk — **£99.95** — Includes Complete Cash Book Accounting System, as described above.

C.0819 — Cassette — **£139.95**
D.0819 — Disk — **£159.95** — Bumper Business Combination Pack — includes program 0818 (above), plus Database, Stock Control, and Mailist.

DATABASE

The No. 1 menu driven, user friendly multi-purpose Data Management system with the following features: Dynamic Memory management which allows the huge potential of the 64's memory to be fully used... Search and calculate facility which permits numeric field calculations to be updated by any common arithmetic factor... Searches on multiple selection criteria and high precision sorting... Professional standard record verification prior to entry for greater accuracy.

C.0801 — Cassette — **£19.95**
D.0801 — Disk — **£24.95**

STOCK CONTROL

A superb program which makes extensive use of machine code to optimise the use of the computer's memory and greatly improve speed.

Up to 220 stock records may be held on each file with details including stock reference code, description, supplier name, quantity in stock, cost price, sale price, etc.

The program includes the facility to add/modify/delete records, sort, search, enter stock in or out, or produce a stock summary. Several printout routines are available, and a financial summary may be produced giving the total of your stock holding (cost and sale value), the gross profit margin and the replacement cost of bringing understocked items up to minimum stock levels.

This program will take much of the tedium out of stock control and save time and money.

C.0802 — Cassette — **£19.95**
D.0802 — Disk — **£24.95**

MAILIST

A dedicated database to allow for manipulations of names and addresses and other data. Gemini's unique 'searchkey' system gives you a further ten 'user-defined parameters' to make your own selections. Features include the facility to find a name or detail when only part of the detail is known, and to print labels in a variety of user specified formats.

C.0811 — Cassette — **£19.95**
D.0811 — Disk — **£24.95**

HOME ACCOUNTS

A really excellent rewrite for the 64 of Gemini's famous program for the BBC Micro — now enhanced with extra features... Budget for all aspects of household and personal expenditure for each month of the year, and then record and compare actual expenditure as it happens... Complete interactive bank account database with the ability to automate standing order debits... Credit cards supported... Full printer options... Graphic plotting facility to display levels and trends of expenses, at a glance... Highly recommended for putting your 64 to serious work!

C.0807 — Cassette — **£19.95**
D.0807 — Disk — **£24.95**

Gemini products are distributed by: Micro Dealer UK Ltd, Diamond Stylus PLC, Wonderbridge Ltd, Lightning Records, 64 Software Centre and Lansdowne Computers.

Gemini

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Please send urgently CASSETTE(S)/DISK(S) (please delete)

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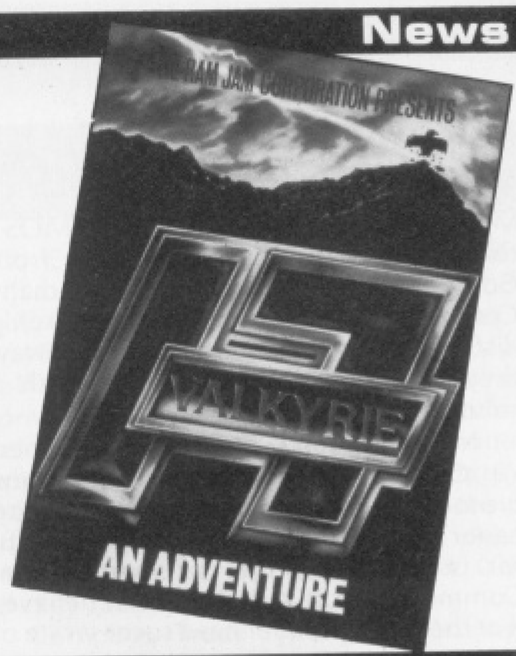
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DATA STATEMENTS



When no news might be good news

I'VE CONCLUDED THAT THE SCARCITY of news on these pages may be attributed to one of two things – either, all the software houses in the country have gone bust and nobody's told us or all the goodies are being held in store for the Summer show season.

The first show of any interest to Commodore users is the 1985 Commodore Computer Show to be held in Hammersmith on the 7th, 8th and 9th of June, 20,000 Commodore fans are expected to attend the show. Commodore are hoping to attract such a crowd with their 'three-machines-in-one' computer – the 128, on show to the British public for the first time. Other attractions will include a computer games arcade and a separate business section and (wait for it ...) celebrity appearances *(then why haven't I been asked? – ed.)*, computer challenge competitions, prize draws and a Music Maker orchestra.

Prize for the 'giga-show' (that's even bigger than a 'mega-show') of the year must go the Personal Computer World Show to be held at Olympia, London from 4-8 September. This caters for trade buyers, business and professional end-users as well as all home computer users and enthusiasts. Not satisfied with last year's one hall, the exhibitors will now spread their wares over two halls – home computing in the National Hall and business in Olympia 2. Commodore are already amongst those who have accepted the kind invitation to attend. The emphasis is on advice, especially to the business end of the market, which will be given through seminars and individual attention at the NCC Micrysystems Centre, for example. What new offerings there will be on the home front, we shall have to wait and see.

From Uncle Sam to RamJam

THE RAMJAM CORPORATION, creators of the excellent 64 adventure, Valkyrie 17, are to serve a three year sentence under the auspices of Ariolasoft. They are following in the footsteps of American companies Electronic Arts, Broderbund and Batteries Included, but are the first British company to sign an exclusive licensing agreement with Ariolasoft.

RamJam's next offering is entitled 'Three Days in Carpathia' and is supposed to be 'sophisticated, witty and very different'. Time will tell!

Ramjam spokesman, George Stone, is certainly happy with the new set-up. He sees it as an opportunity to stick to what he likes doing best – producing games – while the big boys get on with the job of making a profit.

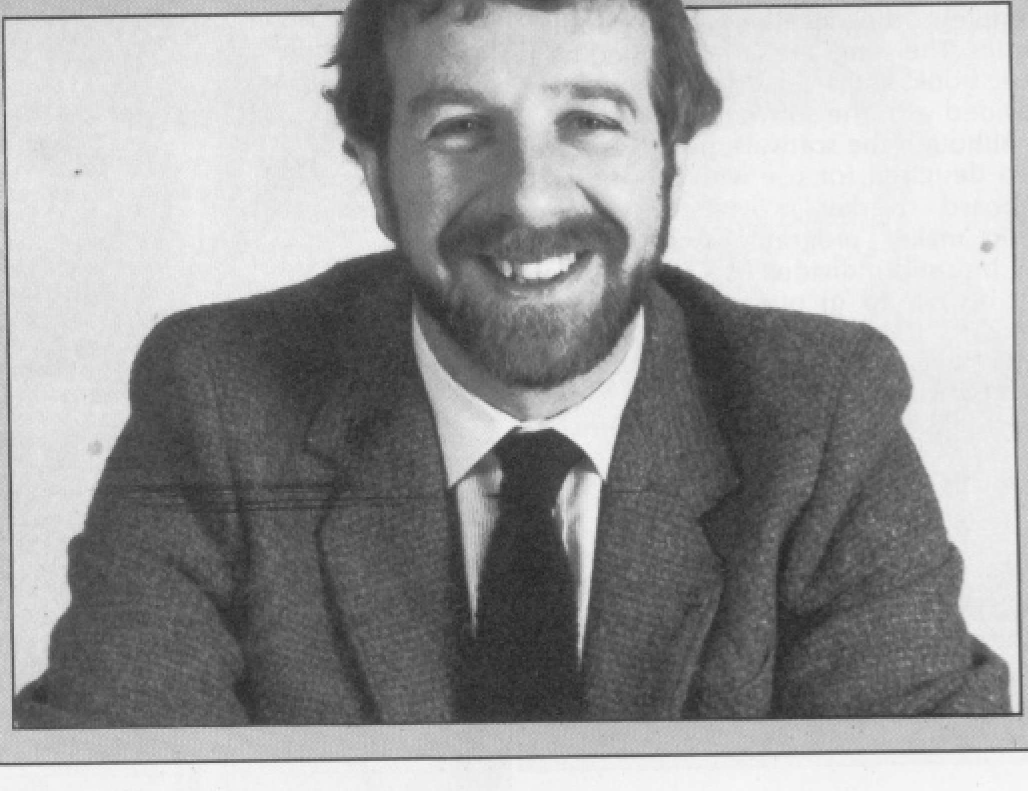
Ariolasoft, Suite 105/106, Asphalte House, Palace Street, London SW1E 5HS. Telephone: 01-828 0720.

Heath is House bound

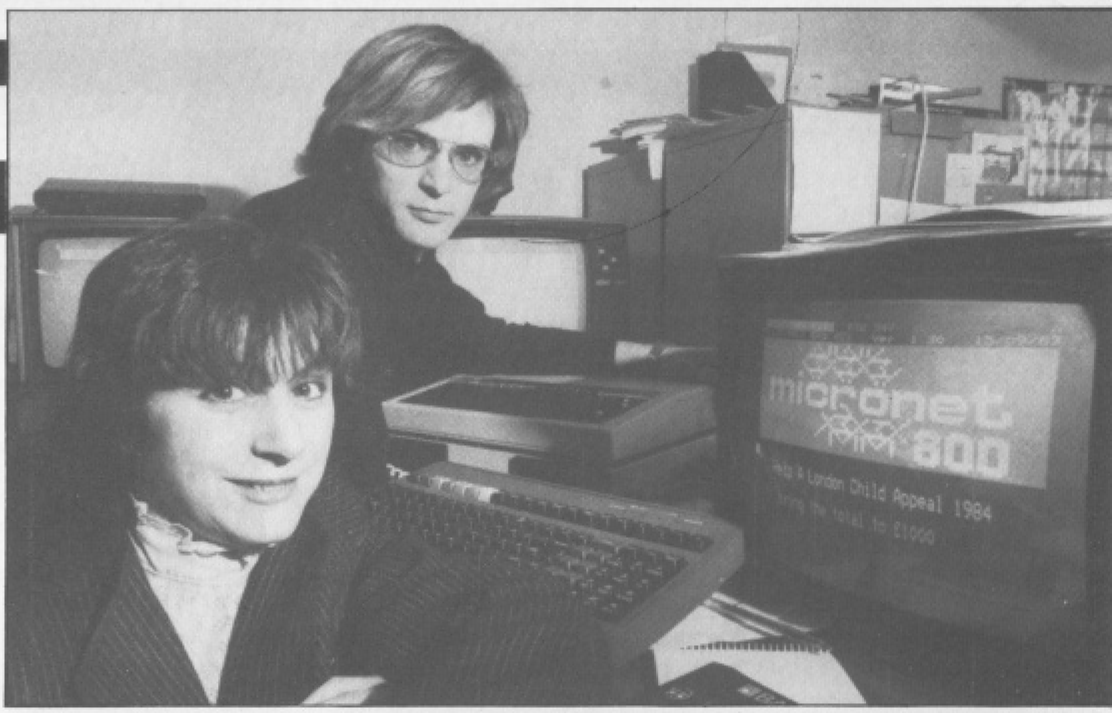
GEOFFREY HEATH HAS SWITCHED ALLegiances from Activision to Melbourne House, where he will be Managing Director and a member of the Board of Directors of the company.

Melbourne House have a staff of 50, including 20 full-time programmers, and already have a fine reputation for producing top qualtiy software. They are hoping that Geoffrey Heath will bless their games with some of that magic which has already made Activision one of the foremost producers of software game. "We feel extremely positive about our position in this very competitive industry and ... are confident that Geoffrey's appointment will greatly benefit our company and its goals", says Alfred Milgrom, Publisher and co-founder of Melbourne House.

Melbourne House Publishers, Castle Yard House, Castle Yard, Richmond. Telephone: 01-940 6064.



Get netted



MICRONET IS DOING ITS UTMOST to entice Commodore users away from Compunet. Having realised that many Commodore 64 programs are not being distributed in an efficient and simple way, they reckon they've come up with a solution.

Micronet 800 has commissioned Y2 Computing Ltd to design a new protocol to make uploading telesoftware easier and downloading more powerful for a wider range of commercial Commodore software. Micronet believes that the new uploader has a success rate of 90%.

Many of the programs uploaded to the new protocol can still be downloaded to the new protocol and, if you bought a cartridge before the change, those generous souls at Micronet will send out new terminal software free of charge. Micronet has given details of the new protocol to a number of manufacturers producing 64 hardware and expect modem manufacturers to adopt the standard.

In a further bid to attract Commodore users, Micronet has established a new communications package for the Commodore modem user. They have re-written their Prestel terminal software for Compunet members to include a down-loader written to the new communications protocol. Previously, Compunet members could only obtain a Prestel terminal package that didn't download any Micronet telesoftware. But, many Commodore modem users weren't joining Compunet so Micronet distributed a complete terminal package for the Commodore modem, thus allowing any Commodore modem user to join Micronet without joining Compunet first.

Micronet 800, Telemap Ltd., 8 Herbal Hill, London EC1R 5EJ. Telephone: 01-278 3143.



Sing-along-a-Mozart

MOZART HAS A LOT TO ANSWER FOR! Following in the wake of his stage and film debut, he is now to be immortalised on cassette or disc.

Commodore hope to teach budding musicians to play a wide range of music with the latest addition to their Music Maker software. There are three choices of albums – pop hits (including Rod Stewart, The Animals or Abba, for example), the Beatles and popular classics. The songs are accompanied by a music book, and an instruction booklet is provided with the software.

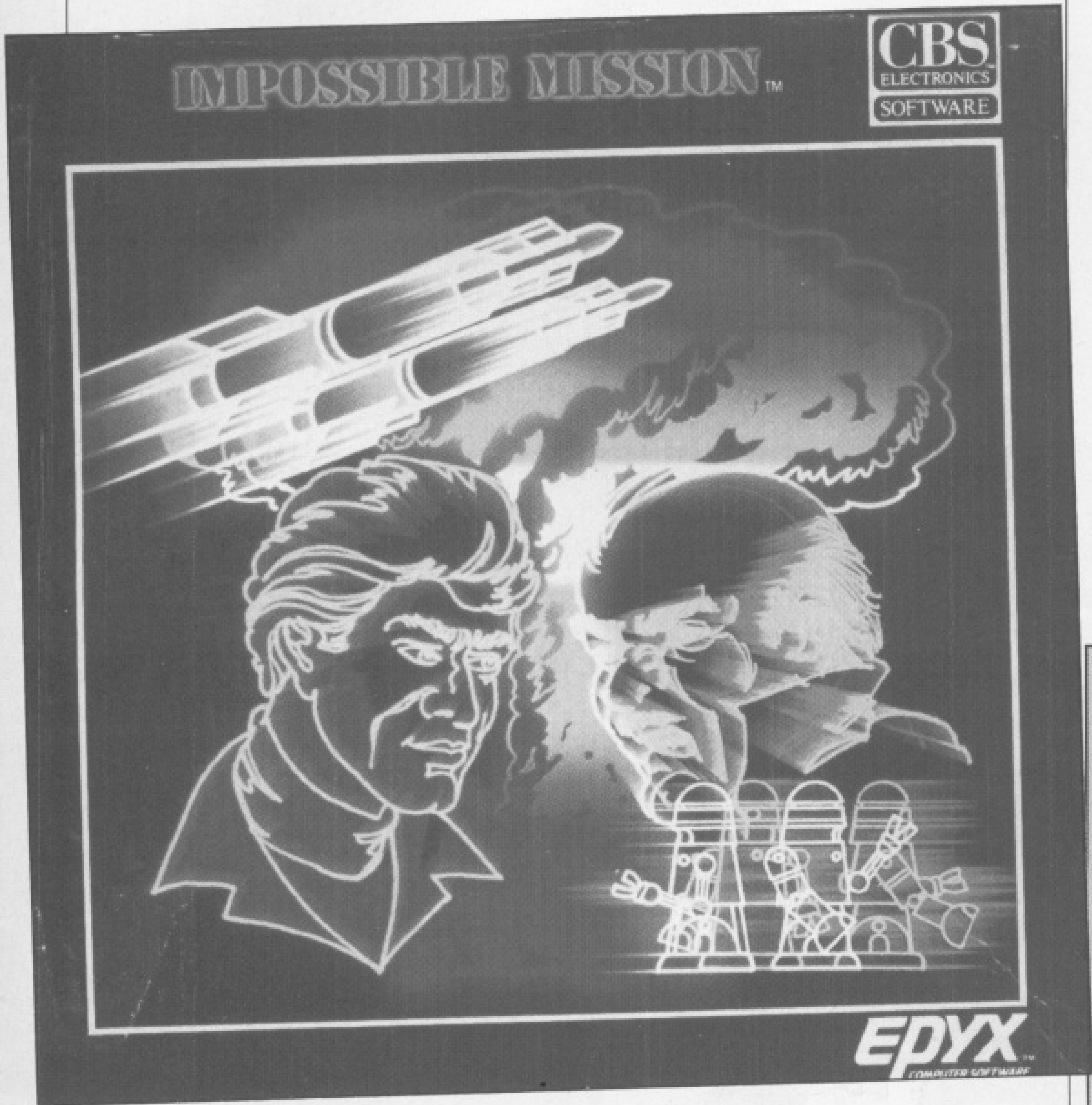
Although the software packages have been designed for use with the musical keyboard overlay provided with the Music maker program, each package may be used individually. Compositions may be played in one of four modes: Concert, Rehearsal, Single Key and Performance. Tuning and tempo may be selected and Midi, Omni, Poly and Mono modes allow the program to be linked with Midi synthesiser keyboards. And, if you really wish to commence battle with the neighbours, you can interface the computer with a hi-fi system.

The Music Maker 'Play Along Albums' cost £9.99 each and are available on cassette or disc.

Commodore Business Machines, 1 Hunters Road, Weldon, Corby, Northants NN17 1QX.



Winners, all!



OUR MARCH IMPOSSIBLE MISSION competition was not impossible after all. We received over two thousand entries, most of them containing the correct password – ACDEB.

The first prize of Impossible Mission plus the complete CBS range (8 titles in all) went to Jonathan Shipley of Hessle in Humberside. The second prizes of Impossible Mission plus three other titles were won by Daniel Clarke of Southampton and M.P. Green of Gainsborough. Two third prizes of Impossible mission plus two other titles went to Ian Langford of Sydenham and S. Cherry of Hithe, and four fourth prizes of Impossible Mission plus one other title were won by Nigel Cook of Ipswich, Andrew Hammond of Hockley, Christopher Packham of Tadcaster and Jeffrey Preou of Braintree.

Congratulations to all the above plus 50 other winners who will all receive one of CBS' great titles. These lucky readers are:

Andrew Skinner, Blackburn; Jotinder Singh Oulakh, Watford; M.J. Harnden, Stamford; Anthony Parkin, Shenfield; Mark Bullock, Halesowen; Simon Renouf, Southwick; Graham Peberdy, Bebington; Mohammed Gulzar, Manchester; Mark Plant, Mansfield; S.R. King, Poole; Keith Button, Waltham Cross; Eric Jackson, Greenhithe; Darren Kovler, Ilford; Mark Seal, Lincoln; Kimberley Gill, Manchester; Brian Coughlan, Co. Cork; Damian Evans, Winsford; Richard Chew, Birmingham; Paul Calf, Bradford; Boyd McAfee, Reading; Roger Robinson, Stafford; Stephen Burchell, Rayleigh; Juan Anido, Kilburn; Andrew Beale, Ipswich; Ian Masterson, Welwyn; Alastair Carter, Rossendale; Peter Kay, Lancaster; K.T. Cheetham, Newcastle-upon-Tyne; Stephen Plant, Glasgow; Philip Wade, Mitcham; N. Allerton, Fareham; Ian E. McLaren, Co. Down; Douglas Leitch, Caithness; Paddy Humphreys, Southampton; Michael Wood, Spalding; Rachel Marshall, Stockport; Lee Stevens, West Bromwich; Andrea Johnston, Belfast; J. Kingsbury, Barry; Austin Bowyer, Littleborough; Timothy J. Weaver, Reading; G. Haywood, Ilkeston; Paul Byrne, Wellingborough; J.W. Smith, Grantham; Stephen Quinn, Ayr; Mr. T. Carnell, Whipton; John Hinds, Barnsley; David Prescott, Wigan; Jeremy Hoare, Eastbourne; Kerry Blake, Peterborough.

Software auction

SOME OF THE TOP SOFTWARE HOUSES will be auctioning their software at the GLC County Hall on Saturday June 15th.

No, this isn't because they've failed to sell their wares through more conventional means. The auction is to be held in aid of the Ethiopian Famine Appeal. Software houses such as Argus, U.S. Gold, Pitman and Gilsoft hope their efforts will make this the biggest ever computer auction and boost the £250,000 already raised by Soft Aid.

Computer Trade Weekly are looking for any old and unwanted software to be included in the auction. Please send your pre-war copies of Space Invaders to:

Computer Trade Weekly
Specialist Retail Press Ltd.
Business Technology Centre
Bessemer Drive
Stevenage
Herts SG1 2DX.

Soft sales

Soft Aid, the brainchild of Rod cousens, ex-managing director of Quicksilva, has already sold over 50,000 copies and is still selling well. The Commodore and Spectrum versions have raised a total of £200,000, at the time of going to press, for the Ethiopian famine appeal fund.

Credit must go not only to Mr. Cousens but also to printing and software houses and distribution companies who have donated their time, skills and services free of charge, and also to retailers who have sold the games at little or no profit.



Stamp collection

Charitable souls also preside in the Your Commodore offices – in fact, in the offices of all the magazines published by Argus Specialist Publications.

Being such hugely popular people, we receive sackfuls of fan mail, poison-pen letters, misplaced shopping lists, etc, etc. every day. And, what is common to every envelope? Yes – a stamp. Well, instead of cluttering up the office bin with all these stamps we've been saving them for a guide dog.

But, we're not quite as popular as we like to think we are. We need a total of over half a million stamps to sponsor the dog.

Without any assistance, this is going to take us an incredibly long time. This is where you kind-hearted readers come in. Why prolong the loneliness of both dog and owner when your stamps can help speed up the process? If you receive a lot of mail, or even if you can save stamps from your personal mail, please send them in to our ASP Guide Dog Appeal.

Please cut out the stamps, leaving approximately 1cm around each edge, put them in an envelope and send them to Guide Dog Stamps, Your Commodore, No. 1 Golden Square, London W1R 3AB.





Errata

In our review of Commercial Products' Numeric Keypads (June issue, 'Push Me, Pull Me', page 26), we bemoaned the fact that this Numeric keypad does not have a RETURN key. But, a spokesman from Commercial Products swiftly told us that our reviewer had no right to complain – the keypad does have a RETURN key. It is marked as an asterisk in the right-hand bottom corner of the original picture.

A likely tale



ONCE UPON A TIME, IN THE BOWELS of the Your Commodore offices, there sat a bored young journalist. Searching for some light relief from the drudgery of pumping news into her flashy new word processor (*wishful thinking – ed.) (This is a fairy story – bored young journalist)*, she espied a box.' Twas not any-old-box, nay,' twas Orpheus' new game, Elidon.

Thereupon, she loaded the game. The screen was painted with a beautiful creature – a faerie who flitted around the secret forest of Elidon, through hundreds of detailed forest glades, in search of the seven magical flowers of Finvarra. On her intrepid journey, in the face of many dark and sinister forces, she was accompanied by the ethereal music of Grieg.

'Tis rumoured that a team of independent graphics designers, several freelance programmers and musicians cast aside their magic powers in favour of spending 5 months in the crypts of Orpheus, developing the game.

But, although faeries may lurk at the bottom of your garden, computer games don't grow on trees. £8.95 is the price to pay for this fantastic journey.

And, should you have trouble buying a ticket, Orpheus may be contacted at The Smithy, Unit 1, Church Farm, Hatley St. George, Nr. Sandy, Beds. SG19 3HP.

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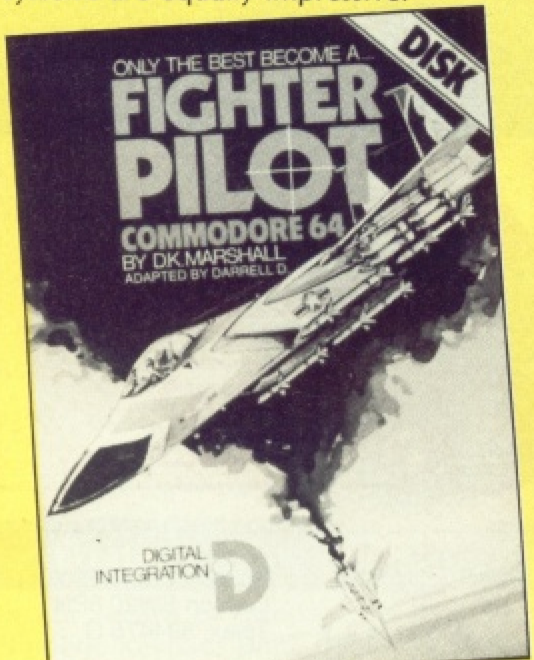
Take to the skies with John Farrar as he zooms on a selection of Commodore flight simulators.

MY FIRST ENCOUNTER WITH A COMPuterised flight simulator was a Psion program on a friend's ZX81. Considering the limitations of the computer I thought it was amazingly realistic. From that moment the hunt was on for a comparable program. It's been a long wait but it's been worth it for now there is a veritable barrage of flight simulators on the market.

The flight simulators are as varied as the types of aircraft in the skies so I have divided them into groups – based on military aircraft, airliners and so on. If plenty of action is more to your taste, then opt for the military versions. Or, should you wish to be responsible for 100 passengers then try flying a 737. The light aircraft versions, especially the SubLogic program, provide an excellent introduction to flight and navigation in general. So, let's strap ourselves in tight and take-off into the wide blue yonder.

Military aircraft

The McDonnell Douglas F-15 jet fighter is a high performance aircraft capable of speeds in excess of 1,500 mph and a ceiling of 65,000 feet. To match this performance, its weapon and defensive systems are equally impressive.



There are two programs available for this aircraft one being **Fighter Pilot** from Digital Integration. This program provides a menu of options enabling the user to select landing practice, combat practice, combat, bad weather etc. All very useful and each good fun in their own right. The main combat task is to shoot down a bomber which is hell-bent on destroying your airfields. If you succeed another appears on the scene and so on. There is an on-board guidance system to help locate the enemy. This is backed up by a detailed map which shows your position relative to the enemy aircraft and your airfields. If you survive long enough, as the bombers shoot back, the fuel situation will become critical, creating the need to land – assuming there is an airfield still in tact of course. Beacons and a landing system are available but it is not easy. The displays are well done and excellent use is made of sound and graphics throughout the program. This program has had deserved success since its launch some months ago. For a fuller review see the April issue.



The other program based on the **F-15 Strike Eagle** from US Gold. In Fighter Pilot the weapons are limited to cannons but in Strike Eagle the full weapon has been incorporated including head-on displays in the cockpit view. Bombs, cannons, rockets, decoy flares, electronic jamming – they are all here. You will need them, plus all your luck and skill, as there are 6 difficult missions to complete. The idea is that you destroy the primary targets on each mission but you will have to contend with enemy aircraft firing air-to-air missiles and SAM missiles sites firing heat-seeking missiles.

Unlike Fighter Pilot there are no take-off or landing sequences. Assuming that you survive long enough, you are airborne throughout. To refuel and re-arm it is only necessary to fly over your home base. Varying levels of difficulty can be selected, with the easiest, Arcade, providing a permanently horizontal horizon. The graphics and sound are excellent and the aircraft responds immediately to control movements. The excellent 36 page manual states that "The F-15 cockpit is a complex and stressful working environment". They are not kidding! I reviewed this program in detail in the May issue.

The final program in this category is **Spitfire 40** from Mirrorsoft. There are just three scenarios to choose from: practice, combat practice and combat. You are a young Spitfire pilot in 1940, and must undergo thorough training before going into combat against the might of the Luftwaffe. So, once again, plenty of practice is required.



Three displays can be called up the instrument panel, which is brilliantly done, the view from the cockpit window and finally a map of the South East of England. The scale of the latter can be altered, which is useful, as it is used to locate your airfield and the enemy aircraft. I was not too keen on having to toggle between the instrument and cockpit displays, as I found it broke the continuity of the program, particularly for landing approaches. However, if it was



necessary in order to provide such an excellent instrument display then I'll put up with it! I would have liked the aircraft, shown on the map, to move, but the manual states that this is a means of providing a 'pause' in the program, which it does. Oh well...

The program aims to simualte the flying characteristics of the Spitfire and the epic dogfights of those 'Famous Few'. It easily achieves this with excellent use of the 64's graphics although the sound can get a bit monotonous on a long sortie. One good idea is the ability to save your flying time and 'kills'. I would like to see more use of this facility. The accumulation of hours and skill raises your rank through the R.A.F. 60 hours and the rank of Group Captain allows you to enter a Mirrorsoft competition. So "Tally Ho! chaps".

Airliner

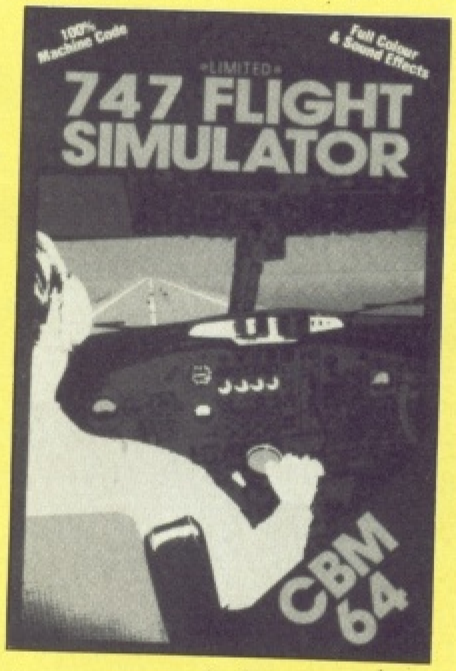
Flight Path 737 by Anirog has been around for some time now. The objective is to takeoff from the home airfield, fly over some mountains and land the other side. That's all there is to it! There are the usual levels of difficulty but the lowest is hard enough. The cockpit instruments are of the digitaly type and are clear and concise.

From takeoff to the landing approach sequence, it is necessary to keep within the parameters for various controls. For example, the flaps cannot be raised below 300 feet and at less than 160 kts. The mountains are well drawn and the graphics and sound are adequate. I found lining up the aircraft with the runway, at the start of each flight, a little tedious. My real gripe is with some awful spelling on one message "ACCENT TO SLOW" Yuk! This is inexcusable. The cassette label claims that this is an 'Advanced flight trainer' which I think is going a bit far. Nevertheless, I found this program to be good fun and very addictive, which is, after all, what software should be.

Doctor Soft's **747** flight simulator was written with the assistance of a British Airways captain, this program allows you the freedom of the north eastern European air routes. Starting initially from Heathrow, you can select your destination and, assuming you have developed the necessary skills, you can roam the skies to your heart's content using navigation beacons.

The Keyboard controls are sensibly allocated (B=brakes,F=flaps etc) and practice modes are available. When the joystick is moved left or right, the horizon tilts accordingly on the simple, 30 view through the window. Environmental conditions can be reset to alter cloud base and top, day or night flight, windspeed, and the starting point can be changed.

An added feature is a fantasy zone with weird shapes and effects located over the North Sea. The documenatation fully detailed with the emphasis on navigation.



Jumbo jet controls become the main concern to users of DACC's **747 Flight Simulator**. The engine guages alone give the individual status of each engine with regard to spool speed, gas temperature, pressure ratios and fuel flow. Flaps can be partially extended, aileron and elevator positions are shown and a warning panel flashes signals to the pilot of impending trouble, emphasised by an audio signal.

One disconcerting feature of this program is that although the artificial horizon on the instrument panel indicates that the jet is banking, the view through the cockpit window remains resolutely horizontal.

Navigation is performed with the aid of a simple direction finder, leaving the pilot to worry about landing preparations.

The flight manual gives full instructions on the purpose of each gauge but a few words on flight principles would not go amiss.

Varied

The aircraft in this section are as different as chalk and cheese. One simulator is for a helicopter and the other for a glider.

The helicopter simulator is **Super Huey** from US Gold. I understand that it is also available from Audiogenic label a few £s less than the £11.95 for Super Huey. Helicopters are a familiar sight in the skies over my home, in SW Cornwall, with hardly a month going by when we don't hear that another dramatic rescue has been carried out. The Fastnet Race of a few years ago vividly springs to mind. Therefore, it was with eager anticipation that I loaded in Super Huey for the first time.

As with most of the flight simulators already mentioned, Super Huey is accompanied by a comprehensive flight manual. Once again, essential reading, as rotary-wing aircraft are a 'different kind of flying – altogether'. You will learn terms like cyclic mode and collective mode, which relate to the control of the rotor blades and the tail rotor. A joystick is a must for this program, preferably with the fire button on the top, as it is used to toggle between modes. There is the customary practice session to help you 'get off the ground'. The on-board computer guides you through the stages of take-off, flying and landing. At this point I have to say that the graphics and sound effects are stunning. The cockpit display is incredibly detailed and, as the helicopter gains height, surrounding buildings and radar aerials dwindle in size. Pushing the stick forward provides forward momentum and soon trees and bushes are whizzing by the cabin screen. Climb to over 3000 feet and they disappear from sight. All the while, you are accompanied by the familiar sound of the engine and rotor blades. Great stuff!



This sets you up to tackle the other missions on the program. These are Rescue, Combat and Exploration. As they have to be loaded separately, it is necessary to record the tape counter readings in order to quickly locate each program. I have to say that, after the promise of the training flight, I found

these other missions to be a great disappointment. The manual, which explains the physics of helicopter flight in some detail, does very little to explain how to accomplish the missions. Neither are the on-board computer and radar systems particularly helpful. The graphics in Rescue are awful, bearing no resemblance to mountain terrain at all. In Combat, the fire button fires the rockets and cannons, but it also controls the aircraft!! It is necessary to type three letters to access the various systems. R A D for Radar, for instance. Surely, just R would have done? In addition, the program rarely reacts to keyboard presses as it should.

It is almost worth buying the program for the training flight alone but I have to say that it is a great shame that the other missions were not better implemented. Perhaps there is a MK2 version on the way? I hope so.

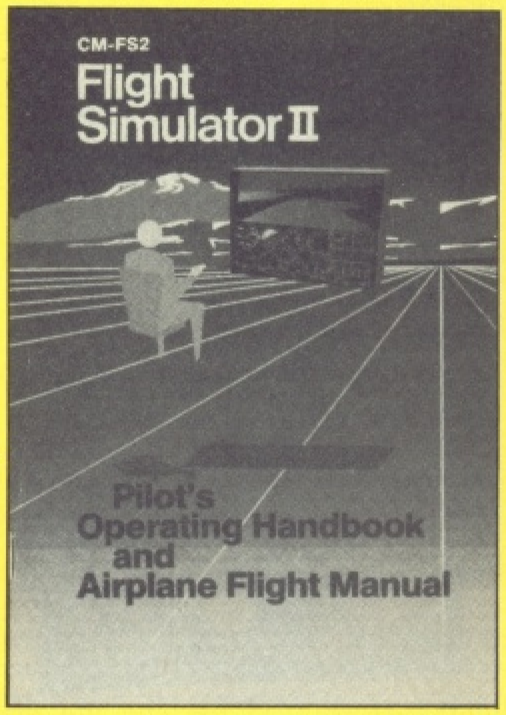
Glider Pilot by CRL provides the user with just one task – that of flying a triangular course of approximately 160 kms. To provide variation to this objective, the program has five levels of weather conditions from which to choose, or you can program your own.



The manual explains the techniques of cross-country flight and soaring in sufficient detail for the uninitiated. The program takes some time to load and, having done so, the most awfully monotonous tune drones out. Perhaps it gets better but I never listened beyond the first few notes!

Once the choice of weather conditions has been made, you find yourself at about 1,800 feet, close to the start line. Crossing this starts a clock running as you are competing against time. The graphic display of the analogue cockpit instruments falls far short of what one expects these days. The clouds, where the thermals that provide lift for soaring are found,are very chunky in appearance: sprites should have been used for these. To give the impression of movement, an attempt has been made to provide 3D perspective ground details. A good touch is the provision of a detailed graph showing the vertical path of the glider through the air.

For those already with a declared interest in gliding then I would think that this program would have some appeal. For the rest, I would say that this program would soon be confined to the shelf due to lack of addictive qualities. At £8.95 you would certainly need to be among the former group.



Light aircraft

Solo Flight by Microprose was one of the first flight simulators to appear for the 64. In the States, some 18 months ago. Since then it has had deserved success in the UK. The aircraft, in this simulation, is a single-engined 1930 vintage monoplane. But this model is fitted with up-to-date VOR navigational radios. The cockpit graphics are adequate, if a little uninspiring but everythin is clear and concise except for the artificial horizon display which is too small. This simulator differs from all of lthe others in that you are flying an aircraft in front of you. The cockpit instruments and the view out can be seen, while in the distance is the aircraft that you are flying! After the others, this takes getting used to, but is, nonetheless, very enjoyable to 'fly'.

The program loads quickly and then provides options of three areas, Kansas, Washington or Colorado. The former has flat terrain and the latter hilly terrain. There are skill levels with varying weather plus a Mail Run game. In this it is necessary to deliver bags of mail from one airfield to another, against the clock and in increasingly bad weather. The aircraft is also liable to mechanical failure.

The manual covers all of the usual flying characteristics of the aircraft and also explains, in some detail, the techniques of VOR navigation and instrument flying. Three area maps are provided to help locate the many airfields but I felt that they could have been larger and more detailed. Nonetheless, this is a very enjoyable program, with enough options and built-in 'fun' to keep you amused for hours. I understand that a MK2 version is to be launched soon so I would welcome the opportunity for a 'test flight'. If Solo Flight (MK1) has been improved. It will be very, very good.

To say that I am a fan of the next program would be an understatement. I refer to **Flight Simulator II** by SubLogic. I could take up most of this magazine explaining the finer points of this program but let me give you just a taste.

The aircraft simulated is a Piper Cherokee Archer, which is a single-engined, fully aerobatic aircraft. The program comes with two manuals, each of 90 pages. One explains the workings of the program and fundamentals of flight and navigation, the other covers flight physics and control in greater detail. In addition, there are four extremely detailed navigation maps covering the areas of Chicago, Los Angeles, Seattle and New York/Boston. It is possible to position the aircraft at any of 80 airports in these areas, and fly between them!

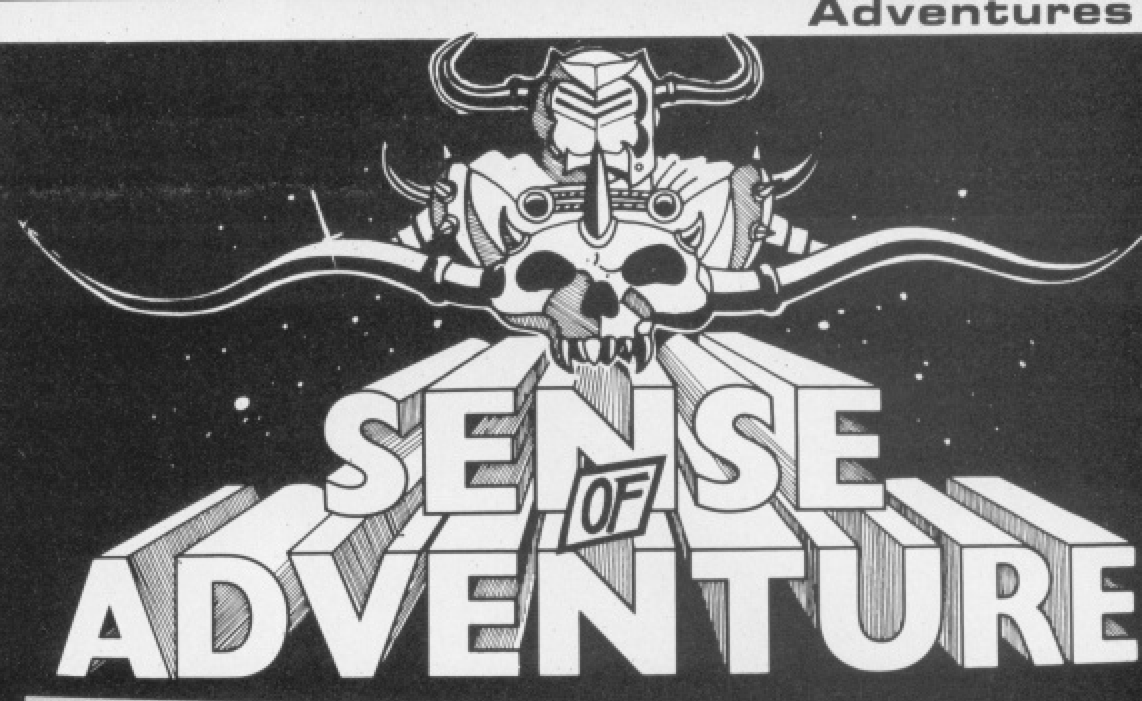
The instrument display graphics are exceptionally detailed but the 3D (solid, not wire) perspective cockpit view is something else. One of my favourite 'flips' is to take off from Kennedy International and pass by the Empire State Building, the United Nations twin blocks and out into the Sound for the Statue of Liberty. Incredible stuff. Sound is equally impressive .

Using the comprehensive 'editing' mode, it is possible to set up any parameters you require. Cloud at two levels, three levels of wind height, speed and direction, plus surface wind. Time of day and seasons of the year can be set. Any position and attitude of the aircraft can be pre-programmed and all this can be saved onto another mode disc if desired (there are nine pre-set modes though!).

Finally, there is a World War 1 combat program included for some bombing and shooting practice from a biplane. Quality such as this does not come cheaply but, my goodness it's worth it.

Flight simulators require the concentration and coordination of arcade games, the strategy and skill of adventure games, with the player in a quasi real-life situation. I find them fascinating and absorbing as I'm sure you will. Happy landings!

Open your eyes to a wealth of adventures with Runecaster's guidance.



TWO MORE BOOKS FOR THE FRUSTrated adventure games-player may just save the odd one or two of us from really going over the edge. They are **The Adventurer's Companion** by Mike and Peter Gerrard and **The Commodore 64 Adventurer** by Bob Chappell.

They both follow an almost identical layout and each deal with just four well known (and frustrating...) adventures. At the beginning of every section is a list of the 'problems' that you are likely to have found. This is followed by numbered references to each of these 'problems'.

Sections and cross refences are laid out in such a manner, so as not to make it too easy to learn more than you need at any one time. This will hopefully not spoil your continued enjoyment of the game. However, you will have to be strong willed not to browse!

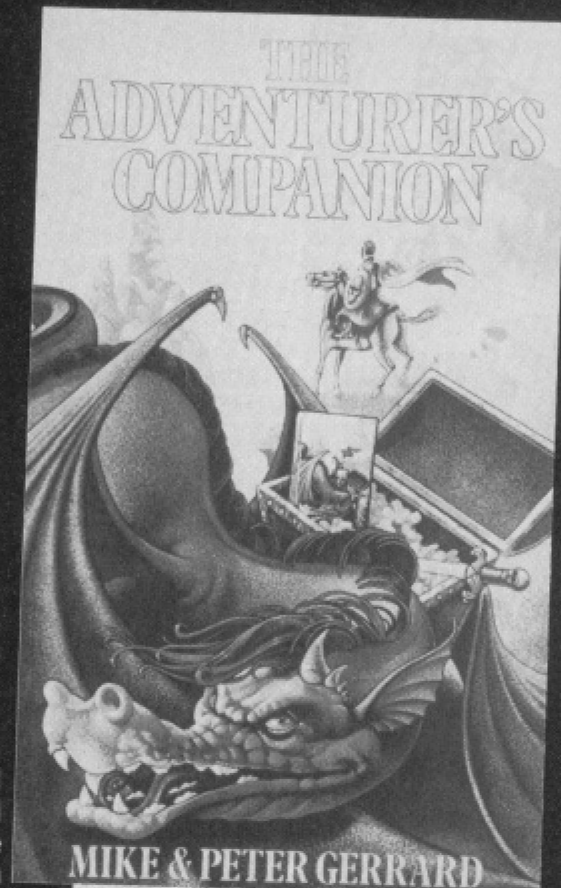
Both books have appendices at the back with complete maps of the listed adventures: so again, no cheating!

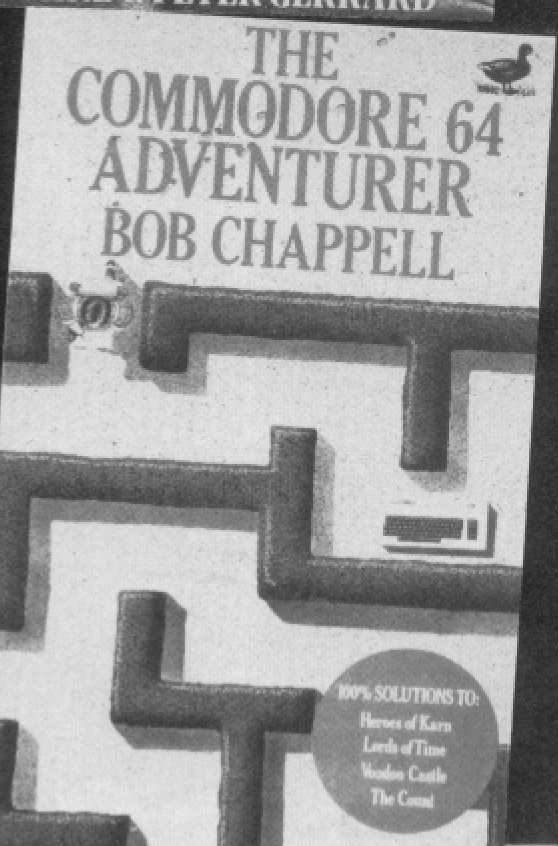
The Adventurer's Companion covers The Hobbit (Melbourne House), Colossal Cave Adventure (Level Nine), Adventureland and Pirate Island (Adventure International).

The Commodore 64 Adventurer complements this with Heroes of Karn (Interceptor Micros), Lords of Time (Level Nine), Voodoo Castle and The Count (Adventure International).

Both are published by Gerald Duckworth and Co., are £3.95 each and should be available from any good supplier of computer titles. Some people frown on the use of such books but you only have to look at the regular pleas for help published in the computer press to realise just how welcome they will be.

If you are in dire need of a friendly shoulder to cry upon then, short of contacting me, remember the Adventurer's Guild of Gravesend, Kent – not only will they sell you all the latest and best adventure games but they themselves are total enthusiasts. Their free hints, Adventureline, is open to all. Write the number down now: 0474 334008.





Loading problems?

Adventures are often very large programs and now that there are a number of 'fast loaders' available for the Commodore 64, we have got rid of the frustration of fifteen minute loading times. Sadly this has introduced another possible area of concern – the C2N cassette recorder!

Fast loaders stretch the capabilities of your system to the limit. This means that not only should the heads be clean but also that they should be accurately aligned to accept *all* of these high speed signals. Many of the tapes sent back as not working are perfectly alright: often it is the cassette recorder that is not up to scratch. Although there is always the risk of aggravating the situation, at some stage you have got to consider re-aligning the recorder's heads. This can be done by trial and error but the adjustment is quite critical and this method is not to be recommended!



Recently, Interceptor Micros have produced an 'Azimuth Head Alignment Tape', price £7.95, that should take the uncertainty out of this operation. The kit consists of the alignment tape, a screwdriver, a crude but effective card pointer and pretty comprehensive instructions.

If your heads (!) are out of alignment, this may be because (1) they have never been critically aligned or, (2) the heads have moved out of alignment. The adjusting screw is usually sealed in position with a dab of paint. In case (2), this may have cracked and the screw turned slightly, due to the vibration caused by the cassette motor.

Run the tape and follow the instructions but whatever you do, *before* you move anything, take a careful note of the present setting! The simple card pointer that is supplied may be taped or stuck to the screwdriver . . . use it. Do not be tempted to 'have a twiddle to see what happens', you could spend the next hour trying to find where you started from!

The adjustment for fast loaders is quite critical and you will probably find that only a small amount of movement will sweep you right through the working area.

The tape consists of the working program recorded at normal speed, followed by data that the program reads – recorded at high speed. Once 'zeroed in' on this high speed data, a number is incremented, showing a count from 1 - 8000. Move off the setting and the count is zeroed and starts again as you come back on tune.

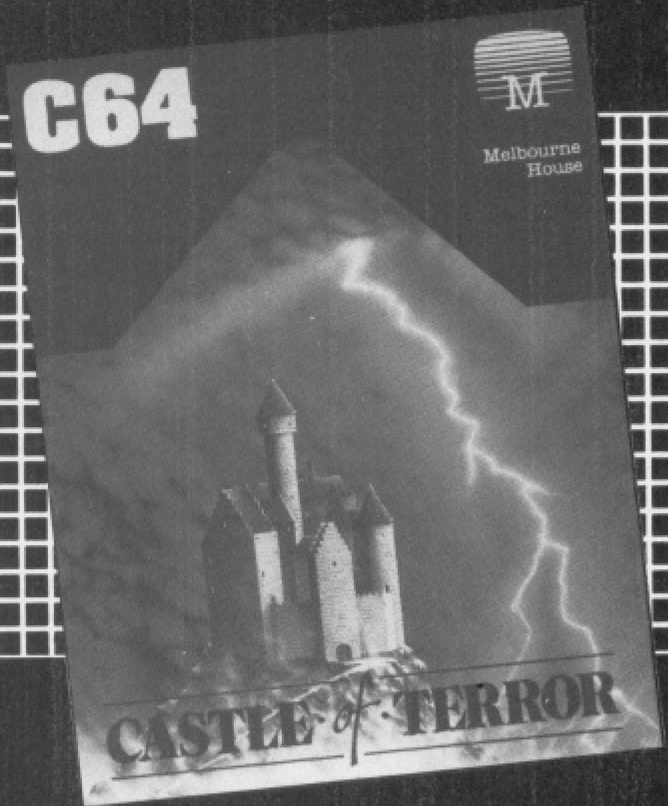
This system is crude but effective, providing you are not far off when you start. As was said above: make sure you know where you started from! Having got the correct alignment, re-seal the adjustment screw, either with a drop of nail varnish remover (to soften and re-use the original paint) or a drop of paint (preferably cellulose). Whichever you use, one tiny drop on the end of a cocktail stick (or similar) is quite sufficient . . . do not get any in 'the works'!

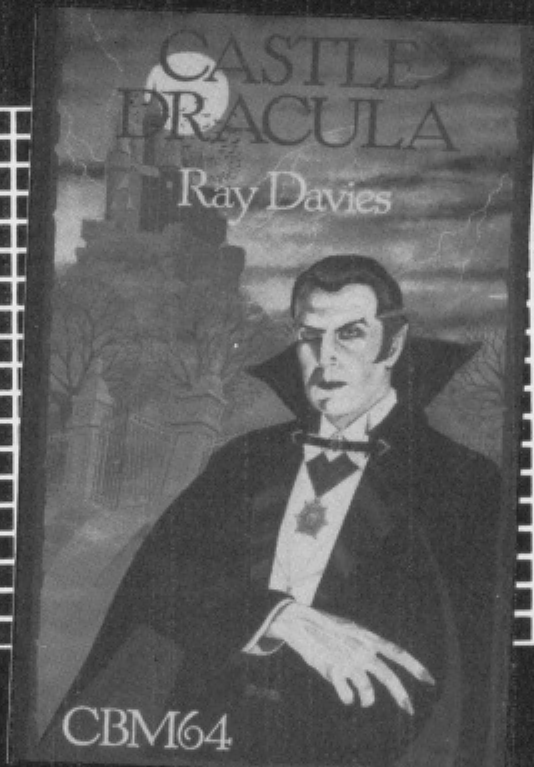
Out for the Count...

Count Dracula seems to have fascinated all those that have heard of him ever since Bram Stoker first put his name to paper! One of the all time classics is Scott Adams **The Count** and he has turned up in numerous other scenarios featured as adventure games. Not always by name, but the hint of a flowing black cloak coupled with the odd stake lying around, have all us adventurers looking over our shoulders and checking the condition of our necks!

Two more adventures for the CBM 64 using this now familiar theme have recently been added to those on offer. The first of these is from Melbourne House (still trying to find a successor to The Hobbit. . .) called **Castle of Terror**; the second is from Ducksoft (still trying. . .) with **Castle Dracula.**

These two, although having the same basic theme, are two very different games. That from Melbourne House gives the impression of the more polished program; with excellent music and good graphics (a different one for each scene). Whilst that from Duckworth has no graphics or music.





Castle of Terror has the more convoluted, devious plot with many pitfalls for even the seasoned adventurer. Buy the 'old man' a drink before the correct time and not only have you spent your hard earned coin, which you apparently cannot replace but you have also missed your opportunity to get the clue he might otherwise have given you!

The music is really something for the first ten minutes; after that you may be forgiven if you turn the sound down. The graphics are good, with a few animated sprites thrown in for good measure. There is no way to turn the graphics off to speed up the response time but the scenes are drawn quickly, leaving a six line window below them, within which scroll all text responses. Sometimes more than six lines of text are scrolled through fairly quickly so you have to keep your eyes skinned.

Complex sentences are recognised but only a few shortened forms of words are acceptable: EX for EXAMINE is nice but DRAWBRIDG is not understood, you must use the full word DRAWBRIDGE! This sort of input is soon mastered but is frustrating to start with.

Castle of Terror is rather reminiscent of some of the Scott Adams games, with several devious twists and the feeling of puzzles within puzzles. It isn't a game I would recommend to the novice but certainly one for the dedicated puzzle solvers with time on their hands. Loading time is less than four and a half minutes (even if the instructions say less than three!). Beware typing QUIT, it means just that – once invoked there is no turning back – try RESTART instead.

Not surprisingly, you may SAVE GAME recording your present position in the game, to return to later (SAVE by itself gets a "don't understand" message). This rather important function is not mentioned in the instructions and only becomes apparent when inspecting the vocabulary with the VOCAB command.

Castle Dracula by Ducksoft has no graphics or music but, as regular readers will be aware, I have always felt that, unless these materially add to the game, I would rather have the speed of response and let *my* imagination loose on longer descriptions.

A fast loader is employed and loading time is about four and a quarter minutes. Response time to input commands is fast and text is scrolled until the next location description is called for. Colours are used very sensibly and the display is easy to read.

Location descriptions are not very long but there are about 100 of them so be prepared for fairly long sessions! There are a number of humorous responses that add to the fun.

Only the first three letters of the input

commands are scanned so the impatient are well catered for. Complex sentences are not understood, which at least means you know exactly where you stand, as a simple VERB/NOUN entry is less likely to be misinterpreted. Movement is only in the cardinal directions and single key entry is accepted.

Instructions are minimal – just those on the back of the box, so although you know your purpose (kill the Count) anything extra you must sort out for yourself! You may SAVE GAME (pretty quickly too ...) to continue later – you'll need to!

General impressions are that Castle Dracula is a well planned game in a fairly classic style, a little thin on the descriptions for a text only game and rather an out of date command interpreter that cannot even disregard THE (GET THE BALL – is not understood, you must revert to GET BALL). It is a good game to play but I doubt if it will have the holding power of some other games on the market.



The worst yet?

I recently got a copy of a game that has been out for some time – **The Quest of Merravid** (Martech Games); it must rate as one of the worst I've come across! BUT it has a strange fascination ... it is not an expensive game and has the makings of a good beginner's adventure!

The Quest was written before the days of fast loaders and takes just over seven minutes to load. I believe it was first produced for the VIC-20 (plus the 16k extension pack) and so some of the limitations imposed by memory considerations must be taken into consideration ... mind you, does anyone remember "Cracks of Doom" by Supersoft for the 16k(?) PET – that was a 16k cracker!

This tape has versions for the CBM 64 and the VIC-20 (one on each side) ... so at last we can mention the other major Commodore machine in Sense of Adventure! Keep looking you Plus 4 and C-16 users, we may yet have something for you!

The Quest is text only and the choice of colours is not so well thought out as Castle Dracula above. Some text in light red on light blue is not guaranteed to achieve good results on anything but a monitor but it is still readable.

The display layout obviously has strong leanings to the size of the VIC screen with some words joined together where previously they were the last and first words on consecutive VIC lines!



The now accepted single key movement commands are not recognised. The format GO N or GO NORTH must be used to travel around. Also, surprisingly, you have to enter the complete word for it to be actioned ... BUC, BUCK, BUCKE will not be understood but BUCKET will.

It also has a naughty habit of answering a command concerning an object that is not at that location ... try typing GET PLANT anywhere and you get "It won't come out of the ground"!

There are some classic anomalies ... visit the busy tavern and hang around drinking – all the people "drift away" ... press LOOK and miraculously all is as it was – the original location message appears and the tavern is busy again.

There are other howlers too ... KICK THE PLANT and find that "It's snapped off at the roots", try to GET PLANT and "It won't come out of the ground"! There is also the beauty where "You are in a dungeon; you can see nothing ... it is too dark AND A KEY"! Try to OPEN ALE and be told "You haven't got a key".

It has a few slightly more annoying faults such as clearing the screen before answering your commands – this means you have to LOOK if you have forgotten the visible exits (it is quicker to type GO...) and it has no SAVE GAME facility, in fact it appears to have no QUIT either – definitely a case of 'do or die'!

It is really a little unfair to go on, isn't it? For all its shortcomings The Quest of Merravid is the sort of adventure one could well cut one's teeth on. Let's face it, you should not be attacking the plant, except when it is there anyway.

Ignore the anomalies and the game will teach the newcomer some of the arts of adventure gaming. Adventure games are becoming more and more involved so there is always a place for the more basic training ground.

Another oldie

Velnor's Lair is another game from yesteryear (seen ages ago on the Spectrum), based loosely on a Dungeons and Dragons type of game. It has been re-issued for the CBM 64 by Atlantis Software – at the remarkable price, for an adventure game, of £2.99.

It is text only and apart from the normal puzzles, mazes and general misrepresentation that one expects from an adventure game – 'Velnor' offers the player, choice of character type and a passable, if rather random, combat routine.

As this game is produced down to a low price, it does not have a fast loader, so you must wait about thirteen minutes for it to load – just time to make a cup of coffee and put out the cat. You must first choose your character class.

You have three choices: Warrior, Wizard or Priest. This determines how your character will tackle the nasties met along the way – it is not possible to avoid them entirely.

Response is fairly fast and certain abbreviations are accepted but it is not always easy to determine them beforehand! So a certain amount of care must be exercised in this direction.

There is a SAVE GAME facility which you may well need! Sadly, I could not find a QUIT routine ... at one point this was a little frustrating as I got myself locked in a room without the key; the only way out was to switch off and re-load the game.

I expected something like that to happen when I moved that darn stake but I didn't think the outcome would be quite so final (we can't all be perfect all of the time!)

At this sort of price it has got to be good value – you certainly will not solve it in an evening. Once having done so you may well want to try again as a different character type.

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TOP DRAW

Discover the art of creating great graphics with some help from Allen Webb.

MANY C64 OWNERS WHO USE BASIC only will, sometimes, get frustrated with the limitations of the language. This is particularly true of younger users who wish to emulate the authors of arcade games. Short of learning assembler or a fast language such as FORTH, there is little that can be done to ease matters. The idea behind this short series is to provide a suite of 'ready to use' machine code routines which BASIC users can call to achieve some useful graphical effects. The routines have two useful attributes:

1) They perform complex actions in a fast and efficient manner
2) They help fill the holes left by the weak BASIC.

Rather than re-invent the wheel, I have endeavoured to cover new and interesting areas of graphics. As far as possible I will make all of the routines compatible. But, inevitably some zero page locations will be common to more than one routine. This should not provide any problems. The spare area between $C000 and $CFFF will be used so that you don't loose any RAM.

On with the show

In this first part I want to deal with user defined graphics from a slightly different angle. In Commodore computers, the character data is held in a ROM. Each character comprises an array of 64 dots and this can be stored as eight numbers. Each number defines the pattern of dots in each row of characters. Hence, if you can change these values, you can redefine your characters. Easy eh? The video chip in the 64 has a handy little pointer which can be pointed at any character set you want. Additionally, by cunning manipulation of the character table, you can perform clever tricks such as scrolling.

The loader in Listing 1 gives a block of nine routines for the manipulation of characters. Their functions are given in Figure 1.

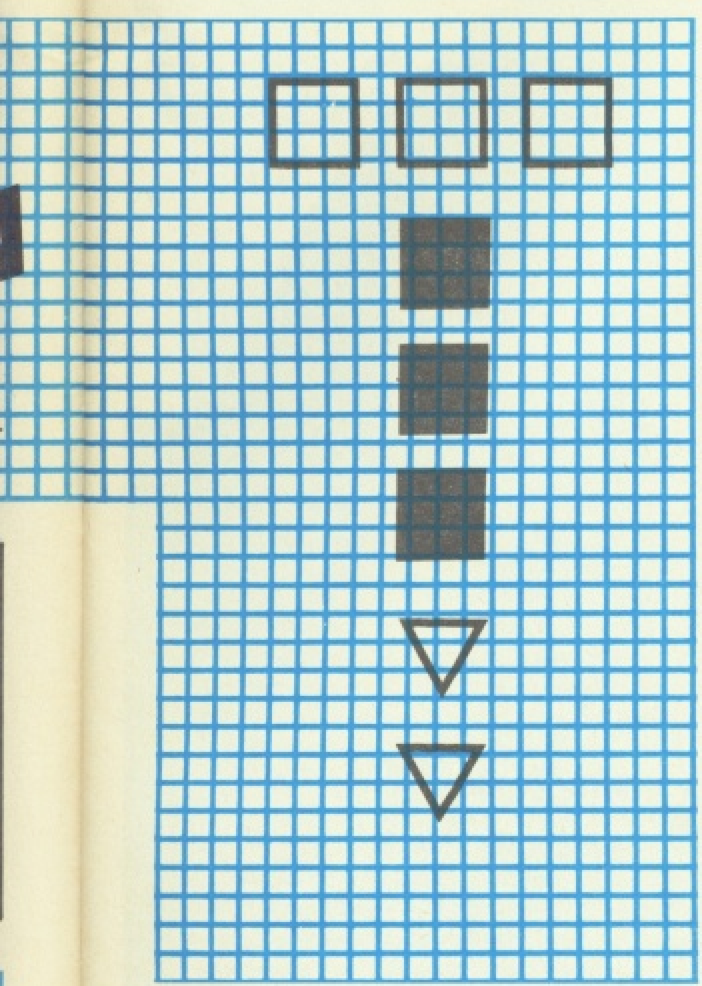
Function	Syntax
1. Set up character set	SYS 49152,address
2. Define a character	SYS 49155,Char,A,B,C,D,E,F,G,H
3. Roll left	SYS 49158,Char
4. Roll right	SYS 49161,Char
5. Roll up	SYS 49164,Char
6. Roll down	SYS 49167,Char
7. Invert	SYS 49170,Char
8. Reverse	SYS 49173,Char
9. Clear	SYS 49176,Char
10. Back to front	SYS 49179,Char

Figure 1

Program Listing 1

```
1 REM CHARACTER MANIPULATOR
2 REM
3 ALLEN WEBB 1985
4 REM
10 DATA76,30,192,76,84,193,76,177,192,76,209,192,76,242,192,76,36,193,76,127
11 DATA193,76,164,193,76,187,193,76,217,193,32,207,193,169,216,141,131,3,169
12 DATA208,141,130,3,169,0,133,253,173,130,3,133,254,165,20,133,251,165,21
13 DATA133,252,141,232,3,141,233,3,173,14,220,41,254,141,14,220,165,1,41,251
14 DATA133,1,160,0,177,253,145,251,165,251,24,105,1,133,251,165,252,105,0
15 DATA133,252,24,165,253,105,1,133,253,165,254,105,0,133,254,165,253,208
16 DATA222,165,254,205,131,3,208,215,165,1,9,4,133,1,102,21,173,14,220,9,1
17 DATA141,14,220,173,0,221,41,3,168,173,232,3,56,249,173,192,141,232,3,78
18 DATA232,3,78,232,3,173,24,208,41,240,13,232,3,141,24,208,96,192,128,64
19 DATA0,32,20,194,32,120,193,32,255,193,160,0,177,251,42,144,2,105,0,145
20 DATA251,200,192,8,208,242,206,239,3,24,208,234,96,32,20,194,32,120,193
21 DATA32,255,193,160,0,177,251,106,144,3,24,105,128,145,251,200,192,8,208
22 DATA241,206,239,3,24,208,233,96,32,20,194,32,120,193,32,255,193,160,0,177
23 DATA251,153,132,3,200,192,8,208,246,160,1,185,132,3,136,145,251,200,200
24 DATA192,9,208,244,160,0,185,132,3,160,7,145,251,206,239,3,208,216,96,32
25 DATA20,194,32,120,193,32,255,193,160,0,177,251,153,132,3,200,192,8,208
26 DATA246,160,6,185,132,3,200,145,251,136,136,16,246,160,7,185,132,3,160
27 DATA0,145,251,206,239,3,208,218,96,32,20,194,32,255,193,169,0,141,237,3
28 DATA32,253,174,32,138,173,32,247,183,172,237,3,165,20,145,251,200,238,237
29 DATA3,192,8,208,232,96,173,238,3,141,239,3,96,32,20,194,32,120,193,32,255
30 DATA193,160,0,177,251,153,132,3,200,192,8,208,246,162,7,160,0,189,132,3
31 DATA145,251,202,200,192,8,208,245,96,32,20,194,32,120,193,32,255,193,160
32 DATA0,177,251,73,255,145,251,200,192,8,208,245,96,32,20,194,32,120,193
33 DATA32,255,193,160,0,152,145,251,200,192,8,208,249,96,32,253,174,32,138
34 DATA173,32,247,183,96,32,20,194,32,120,193,32,255,193,160,0,140,232,3,162
35 DATA0,177,251,10,110,232,3,232,224,8,208,247,173,232,3,145,251,200,192
36 DATA8,206,233,96,6,251,38,252,6,251,38,252,6,251,38,252,24,165,252,109
37 DATA233,3,133,252,96,32,207,193,165,20,133,251,169,0,133,252,96
38 REM
40 FOR I = 49152 TO 49695
50 READ X: T=T+X
60 POKE I,X
70 NEXT
80 IF T <> 73084 THEN PRINT"ERROR IN DATA"

READY.
```



The first command sets up a redefinable character set at a specified address. This address can be any of the permitted locations allowing the use of any of the banks. Figure 2 shows how to set up a character set at $C800. Lines 10 and 20 change the bank and line 30 moves the screen to $C400.

```
10 POKE 56578,PEEK(56578)OR3
20 POKE 56576, (PEEK (56576)AND 252)OR0
30 POKE 648,196
40 SYS 49152,12*4096+8*256
```

The remaining commands alter the specified character, with the second command redefining any character and the eight parameters specifying each of the eight lines of the character.

The functions of the next four commands are self-explanatory. Listing 2 shows how a number of effects can be achieved by the selective scrolling of specified characters. The behaviour of multicolour characters when scrolled is particularly interesting.

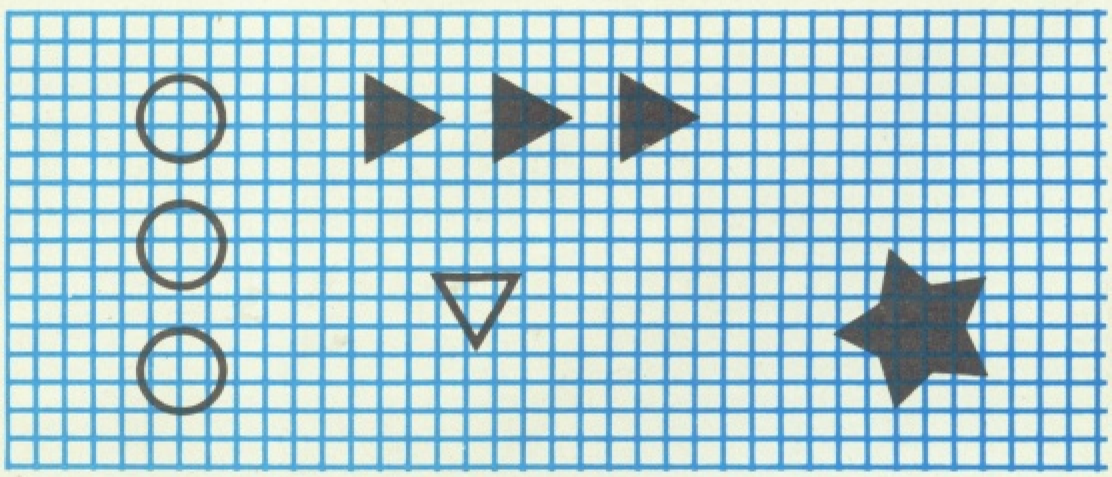
The invert and 'back-to-forward' commands are handy because they let you use a single design for several characters. This is very useful if, for example, you want to have a figure moving back and forth across the screen.

Next month I want to tackle a slightly more obscure area. Most arcade games use colourful effects to portray explosions or blend from one screen to another. I will give some simple routines which can be used to give some interesting effects to your games.

Program Listing 2

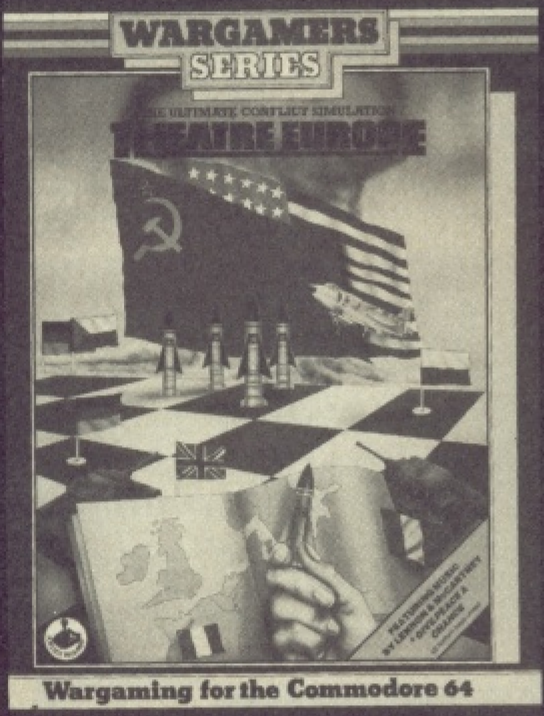
```
10 REM
20 REM DEMO 1 ALLEN WEBB 1985
30 REM
40 DEFFNA(X)=RND(1)*256
50 POKE53280,0:POKE53281,0:PRINTCHR$(147)
60 SYS12*4096,3*4096
70 SYS12*4096+3,7,FNA(X),FNA(X),FNA(X),FNA(X),FNA(X),FNA(X),FNA(X),FNA(X)
80 GOSUB440
90 POKE53270,PEEK(53270)OR16
100 POKE53282,1:POKE53280,14
110 FORJ=1024TO1823:POKEJ,7:POKEJ+54272,3:NEXT
120 FORI=1944TO1983:POKEI,0:NEXT
130 FORI=1984TO2023:POKEI,1:NEXT
140 FORI=56216TO56295:POKEI,14:NEXT
150 PRINT""
160 PRINTTAB(4)"FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF"
170 PRINT"IIII                                        C  "
180 PRINT"HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHCHH"
190 PRINTTAB(18)"DDDDDDDDDDDDDDDDDDCDD"
200 PRINTTAB(20)"EEEEEEEEEEEEEEEECEE"
210 PRINTTAB(20)"                 C  "
220 PRINTTAB(20)"                 C  "
230 PRINTTAB(20)"    GBBBBBBBBBBBBBB"
240 FORJ=1TO10
250 PRINTTAB(22)"CDDDDDDDD":NEXT
260 PRINT"IIIIIIIIIIIIIIIIIIIII"
270 PRINT"BBBBBBBBBBBBBBBBBBBBBBB"
280 PRINT"DDDDDDDDDDDDDDDDDDDDDDD"
290 PRINT"THESE EFFECTS ARE   "
300 PRINT"OBTAINED BY SHIFTING"
310 PRINT"THE CHARACTER SHAPE "
320 PRINT"TABLE.              "
330 POKE1006,1
340 SYS12*4096+6,0
350 SYS12*4096+6,1
360 SYS12*4096+9,2
370 SYS12*4096+12,3
380 SYS12*4096+6,6
390 SYS12*4096+15,5
400 SYS12*4096+15,7
410 SYS12*4096+6,7
420 SYS12*4096+6,102
430 GOTO340
440 DATA 0,64,209,247,255,127,247,191,253
450 DATA 1,223,247,255,127,253,127,247,223
460 DATA 2,0,0,0,204,204,204,255,255
470 DATA 3,129,129,255,129,129,129,255,129
480 DATA 4,85 ,253,253,253,85,223,223,223
490 DATA 5,204,204,0,51,51,0,204,204
500 DATA 6,3,6,12,255,255,48,96,192
510 DATA 8,0,0,0,0,0,0,0,255
520 DATA 9,255,0,0,0,0,0,0,0
530 FORN=1TO9
540 READ A,B,C,D,E,F,G,H,I
550 SYS12*4096+3,A,B,C,D,E,F,G,H,I
560 NEXT:RETURN

READY.
```



IN ARCADIA

Spooks, nukes, rebukes and Ethiopia are just some of the reasons why Flippo has flipped over this month's selection of Arcade goodies.



OUT OF THE MAILBOX THIS MONTH comes a letter from Chris Rogers of Rhyl. He wrote to me about Acitivision's Ghostbusters, saying, "My own personal hi-score is £239,800 – acc. no. 30067010 (CHRIS). I want to try and reach the $1,000,000 mark on Ghostbusters – if the program will accept such a score!" Well, Chris, when I spoke to David Crane at the LET '85 show, he said he had an account number to get $999,999. Whether this was the highest you can get, I don't know, but I'll find out! By the way, David wouldn't tell me what the account number was. Blast!

So, Chris has achieved this month's hi-score for Ghostbusters, second place going to David Edwards of Carlisle with a marvellous $176,600 ("DAVID" acc. no. 46117405): the gauntlet has been thrown down – any takers to just beat this or reach the fabled million? Let's hear from you, pixel-pickers!

David Edwards has this to say about Epyx's fab Impossible Mission: "It took me five days, on/off playing, to finish it. It's quite good at the end. The puzzles don't change, you come across new ones, and they repeat! I think I've found about 20 different puzzles". Thanks for the warning, David. By the way, you didn't tell me what your hi-score was, so the only one I have for Impossible Mission so far is 25101 (password – ASPARAGUS) from Dawn Rogers of Rhyl (Wife of Chris!). Nice one, Dawn; all those somersaults must have made you quite dizzy!

By the way, David, Choplifter predates Rain on Bungleing Bay by about a year and a bit, and Lode Runner is nothing to do with it either.

Several people have written to me asking if I can suggest new games with good speech and graphics. Well, Impossible Mission is about as good as you'll get, at the moment, speechwise. As for graphics, CAD/CAM Warrior (Taskset), Indiana Jones in the Lost Kingdom (Mindscape), the excellent Staff of Karnath (Ultimate) and, out soon, The Rocky Horror Show (CRL). This last has the best music on *any* game I've seen. The game ain't bad either!

Cold sweat

I really scared myself the other day. A copy of Theatre Europe, PSS's new wargame/simulation of World War III, dropped through my door. I booted it up, and started to play. I soon got bored with having to think about troop movements, and battling it out on foot, so (being a shoot 'em up nut) I started throwing my nukes around. Memories of Missile Command made me expect little blippy explosions and a nice safe little message "game over"... I didn't realise this was a *simulation*. I activated all the missiles in the Nato armoury..!

The screen showed a thousand tiny lights moving slowly across the screen, while a thousand tiny lights moved from the Iron Curtain countries over to my side. The silence and the suspense made my mouth go dry ...

Then the map disappeared suddenely, and I was transported ... a picture of a grey city skyline, the silence was fractured by the wall of the air-raid sirens, over and over again. Then a tiny streak of light in the sky, followed by a flash of white brilliance, the rumble of blast, and the stomach churning sight of a mushroom cloud. Over and over again it happened as all the major cities of the world were razed to the ground. I turned off the computer and sat for a moment in silence. War is not funny. (See our fully fledged review next month).

Donald quacks a rib

Donald Duck, on the other hand, *is* funny, and always will be. His new arcade game sees him trying to build a playground for Huey, Dewey and Lewey to play in. He does this by earning money working at the airport, the fruit farm, and the toy shop.

The graphics on this game are delightful, truly cartoon quality, and the sound, especially Donald's voice, are first class.

Feed the world

A further stroke against hunger in the Third World, Soft Aid, the software Band Aid tape, is in your shops. A note from Bob Geldof on the inlay card says "Don't copy this tape, Go out and Buy It!!" I insist that you all do just that and, as for anyone who copies this mega-compilation rather than spend a paltry five quid to save somebody's life ... well, I hope your conscience can take it!

Right, that's all we have space for, arcade buffs. Keep those letters, queries and hi-scores piling in, and I'll see you next month. This is Flippo, signing off.

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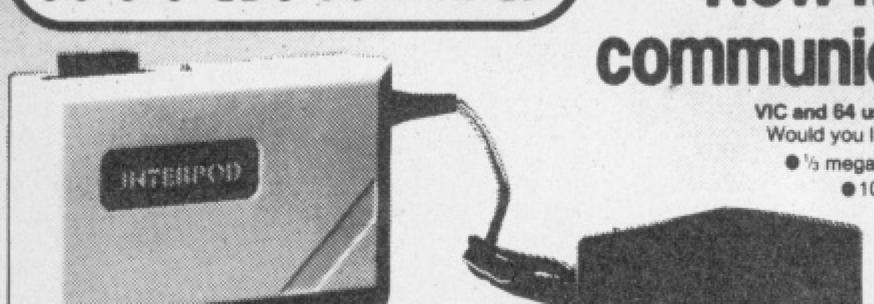
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THE BASIC FACTS

A.P. and D.J. Stephenson explore the mathematical capabilities of programming in BASIC.

PART 10

THE BASIC LANGUAGE TAMES mathematics. Highly complex equations can be programmed with ease and tested with real figures without the customary arithmetic drudgery. The mathematical commands on the Commodore machines are powerful and capable of handling complex equations but it is easy to fall into traps caused by such gems as division-by-zero, unreal roots and unexpected rounding errors.

Translating text book equations

A text book equation can rarely be directly implemented in BASIC. For example, $Y=A^b$ written in BASIC must be written as Y=A^B because there is no provision in BASIC for positioning a variable 'up in the air'. Multiplication is indicated by '*': the equation Y=AB must be changed to Y=A*B else the computer will think that AB is the name of a single variable and an awkward bug will be created.

Arguments within functions must be enclosed in brackets, even though they may be optional in the text book version. For example, a mathematician would write cos X or sin X but we must translate these to COS(X) and SIN(X). In BASIC, a function is a special keyword, characterised by the enclosure of brackets around the variable. It is used to supply the language with a few of the commonly used mathematical operations other than addition, subtraction, multiplication and division such as COS(X), TAN(X), ABS(X), etc.

Degrees and radians

The circumference of a circle is divided into 360 parts. However, BASIC trigonometrical functions expect angles to be measured in radians. Thus, SIN(45) is asking for the sine of 45 radians. If you prefer to work in degrees, you can use the π key for converting radians into degrees. For example:

The trig functions SIN(X*π/2), COS (X*π/2) and TAN(X*π/2) will work if X is entered in degrees.

Logarithmic functions

Some BASIC dialects offer two log functions, one to base 10 (common logs) and the other to base e (naperian or natural logs) but Commodore 64 BASIC only offers the latter.

LOG(X) returns the log to base e. The number e can never be expressed exactly, however many digits are used, but 2.71828 is accurate to 5 digits. It is a strange number which can be calculated to any order of accuracy by use of the series:

e = 1 + 1/1! + 1/2! + 1/3! + 1/4 + etc. etc.

The more places you take in the calculation, the nearer you will get to the true value. But don't go too far. If you calculate the series to, say, 20 terms the number of digits would soon exceed the calculating precision of the machine and any further additions would be meaningless numbers.

The exponential function

EXP(X) returns a value, e where e is again 2.71828 etc. The function crops up in such areas as radio active decay, swinging pendulums and population statistics. This is also an important member of a group known as hyperbolic functions.

Inverse trig functions

ATN(X) is the only inverse trig function directly available since it is the one most commonly needed in practice. But, the range can be extended by using some standard conversion formulae. We have arranged the formulae as defined functions so they can be entered directly:

DEF FNAS(X)=ATN(X/SQR(-X^2+1) (for values of X less than 1)
DEF FNAC(X)=-ATN(X/SQR(-X^2+1)*PI/2) (for values of X less than 1)

We have named the functions AS and AC respectively.

Hyperbolic functions

Normal trig functions are based on the circle. Hyperbolic functions are similar but are based on the curves known as hyperbola.

They are not directly available but can be obtained from standard conversion formulae. They are set out below in defined function form and are true for all values of X:

Hyperbolic sine:
DEF FNSH(X)=(EXP(X)-EXP(-X))/2

Hyperbolic cosine:
DEF FNCH(X)=(EXP(X)+(EXP(-X)))/2

Hyperbolic tangent:
DEF FNTH(X)=-EXP(-X)/(EXP(—X)*2+1

We have named the functions SH, CH and TH respectively.

Use of brackets

When writing down algebraic expressions, we can rely on operator precedence, as the following:

^	raising to powers
-	negative quantity
*	multiply
/	divide
+	addition
-	subtraction

Examples:
5+6*5=35
3+3^2/6+4=6
4-18/3^2=2

However, to avoid errors, it is safer to use brackets liberally than to rely too heavily on operator precedence.

Subroutines or defined functions?

In general, the defined function is tidier and more economical than writing equations in the form of separate subroutines. In fact, the defined function is tailor-made for the job, offering local protection for parameter variables. One reminder – the function must be defined with DEF FN before it is called with FN. Since the definition need only be executed once, however many times it is called, it is best treated as an initialisation task and placed near the top of the program.

Handling simple equations

The majority of equations in technical books present little difficulty. As a simple example, we shall take a well-known equation from the field of electronics to illustrate some of the pitfalls. The formula, as it would appear in text books, gives the frequency of a series of resonant electrical circuits (if you haven't a clue what this is, do not fret – it serves merely as an example):

$$f = \frac{1}{2\pi\sqrt{LC}}$$

Any equation, not just this one, should be examined to see if there are certain values of the variable which could cause a crash. We begin by re-writing it in a form acceptable to BASIC:

```
FR=1/(2*PI*(SQR(L*C)))
```

This will work OK but, if the equation is to be set into a loop which repeats many times, the term in the denominator, 2*PI, is best performed before the loop is entered. If we write, say, C=2*PI somewhere, the equation can now be written:

```
FR=1/(k*SQR(L*C))
```

We may then decide to put it into defined function form:

```
DEF FNRE(L,C)=1/(k*SQR(L*C))
```

The name of the function is RE and the formal parameters are L and C. Later, we might call the function with, say:

```
FR=FNRE(L1,L2)
```

where L1 and L2 are the actual parameters. We could also pass over direct constants:

```
FR=FNRE(2E-1,2E-3)
```

If FR was printed to 4 decimal places, we should get 7.957747.

Watch out for the following:

L or C or both can be zero in the denominator because the square root of zero is a real number but the machine would still output the error message "DIVISION BY ZERO" because 1/zero is infinity.

If one of them is negative, the result is unreal and would trigger the message "ILLEGAL QUANTITY".

But, if both are negative and non zero, the product of L and C remains real and acceptable by the machine.

Scaling problems

The SI system (System International) has been used in technical colleges and universities for many years. Whatever system is used, there will always be some units which are too large or too small for practical measurement. Electronics abound with staggeringly large and small units. For example, the SI unit called the Farad is so ginormous that the total capacitance of the planet earth, treated as a perfect conducting sphere, is only one quarter of a Farad! In practical electronics, even the microfarad (one millionth of a Farad) is a relatively large unit and capacitances of a new picofarads (one million millionth of a Farad) are not at all unusual.

Values like these present difficulties when trying to writer user friendly programs. For example, it would be more practical to input the value of capacitance in terms of microfarads than in Farads. But, you can get into a right old mess by re-writing equations using multiples or submultiples of the unit. The safest way is to convert all values received from user-friendly keyboard input immediately into standard SI units, leaving them in this form until all calculations are finished. For example, our previous formula for series resonant frequency is only true, as it stands, if L is in Henries (SI unit of inductance) and C is in Farads. A suitable request for keyboard input might be:

```
100 INPUT"ENTER INDUCTANCE IN MILLIHENRIES ":L1
110 INPUT"ENTER CAPACITANCE IN MICROFARADS":C1
120 L1=L1*1E:C1=C1*1E-6
```

Line 120 converts millihenries to Henries and microfarads to Farads, ready for direct implementation into the standard equation. Although we have recommended that units should remain in pure SI form throughout the length of the program, when the time comes to print out results, the units can be converted back again to more practical values. Thus, if the result of our equation for fr was 45000 Hz, we might like to print out in the KHz (1000 Hz) so we could write:

```
500 FE=FE/1000
510 PRINT"THE RESONANT FREQUENCY IS ";FR" KHZ"
```

If you follow these guidelines, you reduce the chance of a calculation being a million, or hundred of millions, out.

Quadratic equations

Many readers might be familiar with the following solution for the two answers (roots):

If ax + bx + C = 0, then

$$x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

The presence of the square root in the equation implies that some values of the coefficients a,b and c can yield unreal solutions because mathematicians have decreed that the square root of a negative number cannot exist. The condition for unreal solutions is when 4ac is greater than b. The expression within the square root is often known as the discriminant because it 'discriminates' between real and unreal solutions. When writing equations which involve the solution of quadratics, it is wise to evaluate the discriminant part of the equation immediately because, if the result is negative, there is little point in proceeding further.

But, unreal roots do occupy an important position in the theory of alternating currents in general and the behaviour of oscillatory circuits in particular. The 90 degree operator j allows the two unreal solutions of a quadratic to be expressed in the form:

R+jX and R-jX

Any quantities prefixed by j are the unreal parts of the solution. Solutions which contain a combination of real and unreal terms are known as complex solutions. In order to get the computer to accept complex solutions, you must test the discrimation as before but, instead of rejection, convert it to the absolute value using the command ABS. In other words, change it to positive which is equivalent to reversing the terms within the discriminant. To compensate for this trickery, the operator j must serve as a label indicating that such a trickery has been carried out. The equation needs to be slightly re-arranged so that the real and unreal terms are separated:

Solution 1:

$$\frac{-b}{2a} + j\frac{\sqrt{\text{discriminant}}}{2a}$$

Solution 2:

$$\frac{-b}{2a} - j\frac{\sqrt{\text{discriminant}}}{2a}$$

The character j is just a string character which can appear only in the final printout of the solutions. It can take no part in computer calculations.

Polar and cartesian coordinates

A point in two-dimensional space can be expressed in terms of polar coordinates or cartesian coordinates. Instructions to travel 10 miles on a bearing of 45 degrees, are in terms of polar coordinates. Instructions to walk along a certain street for 100 yards, then take the first street on the right and walk a further 50 yards are given in terms of cartesian coordinates. A moment's reflection on these definitions should convince you that polar coordinates are

sensible in an aircraft or in the middle of the desert but, in a typical city, the destination could only be reached by walking through the walls of buildings.

Polar coordinates measure the distance of a line from a fixed reference point and the angle of the line to a fixed reference line. The distance (length of the line) is called the modulus and the angle is called the argument. Polar form coordinates can be expressed in the form Z (the modulus) and θ (the argument).

Rectangular coordinates define a point in terms of its X and Y coordinates. Figure 10.1 shows both forms.

Converting cartesian to polar:
$Z = \sqrt{X^2 + Y^2}$: θ = ATN(Y/X)

Example: If X=3 and Y=4, then Z=5 and θ =53.13 degrees.

Equivalent programmed functions:

```
100 DEF FNM(X,Y)==SQR(X*X+Y*Y)
110 DEF FNA(X,Y)=ATN(Y/X)
```

To use the functions:

```
200 Z=FNAN(X,Y)
210 A=FNAN(X,Y)
```

To convert from polar to cartesian:

X = Z COS(angle):Y = Z SIN(angle)

Example: if Z = 5 and θ = 53.13 degrees, then X = 5 cos 53.13 = and Y = 5 sin 53.13 = 4

Equivalent programmed functions:

```
100 DEF FNXC(Z,AN)=Z*COS(AN)
```

The function name is XC, (X Coordinate)

```
110 DEF FNYC(Z,AN)=Z*SIN(AN)
```

The function name is YC, (Y Coordinate)

To use the functions:

```
200 X=FXC(Z,AN)
210 Y=FNYC(Z,AN)
```

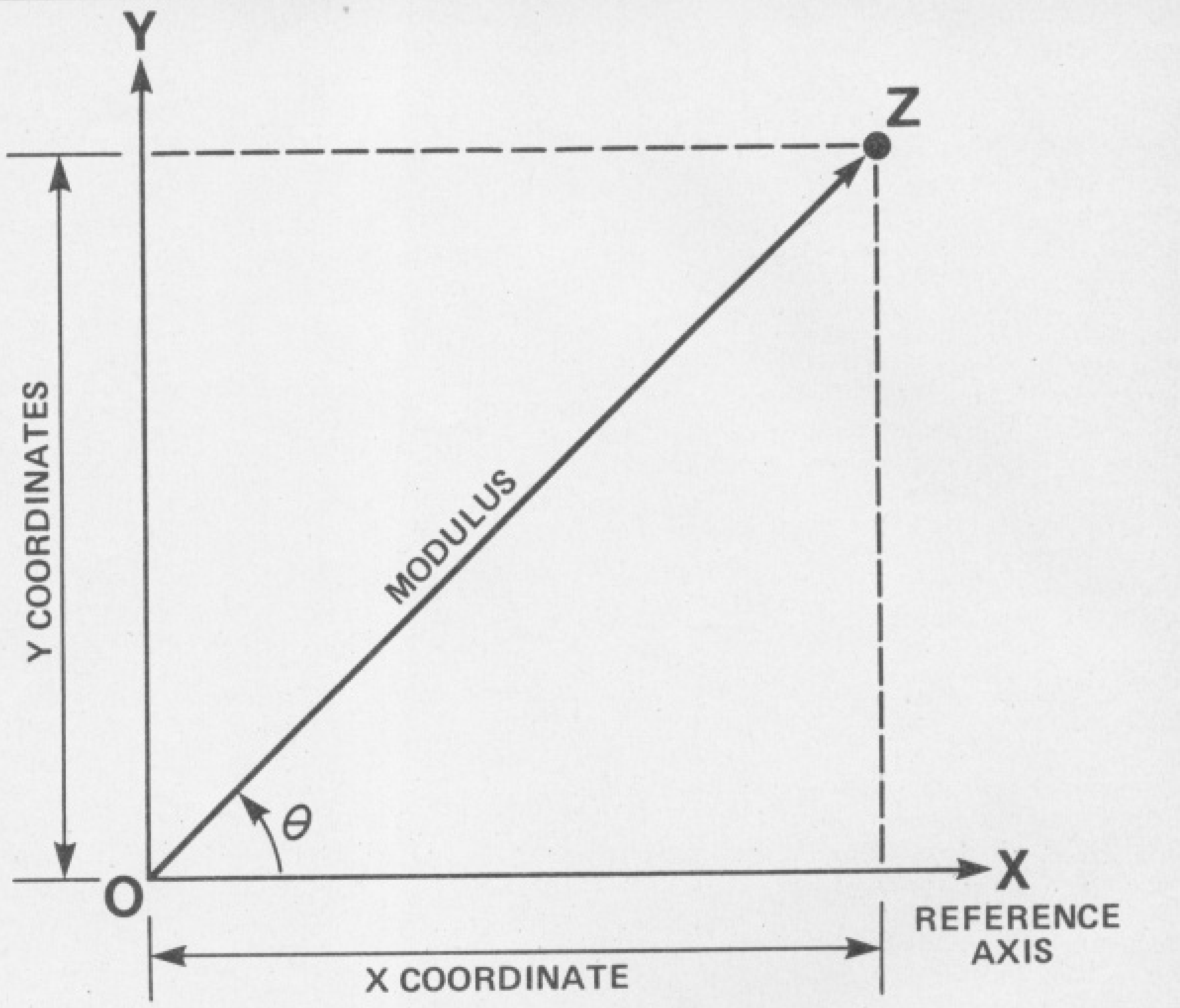


Figure 10.1 Polar coordinates (Modulus and θ) and Cartesian coordinates (X and Y coordinates)

Statistics

Statistics supply us with figures, derived from well proven probability laws but leaves us to interpret them in a common sense manner. It is incorrect interpretation, often quite deliberate, which tends to slur the image of statistics but renders them a boon to politicians and advertisers.

If you present statisticians with a sample of seemingly random figures, they will come up with some predictions but issued with caution. For example, the sample may be too small for reliable predictions to be made. Statistics is all to do with samples. The larger the sample, the higher the confidence factor that the sample results can be extended to the total population. (The term population refers to the total number of items, not necessarily people.)

Collecting the data

Data, as far as statistics is concerned is a set of numbers. What the numbers stand for is not always of importance to statistics. The set of numbers could be shoe sizes or the distance between the navel and armpit of a sample of people. The collection of data is normally a field exercise, the end result being sheets of paper. The figures on the paper will be entered into a computer and one or more statistical formula brought to bear on them. It is a common requirement to find the mean value and the standard deviation of a set of figures. To find the mean value, just add up the numbers and divide by how many numbers there are in the list. The standard deviation is another matter and demands more explanation than we have space for. The formula is usually expressed in the following form:

$$\text{Standard deviation} = \frac{(\bar{X}-X)^2}{N}$$

where X = value of item
$\bar{X}$ = mean value
ZN = numberof items
Σ = the algebraic sum of

We include it because, of all the statistical operations available, it is the most useful and probably the most well known.

Factorials

The factorial of integer X, written X!, is the product of all integers from 1 to X. For example, 4!=4×3×2×1=24. Factorials have a nasty habit of bursting to astronomical values with even moderate values of X. For example, 10! evaluates to 3,628,800 so one problem to watch out for is overflow. The overflow is nearly reached with 30! because it has an approximate value, 2.6E32. A strange feature of factorials, representing another possible hazard, is that 0! and 1! both = 1. Factorials feature prominantly in the laws of probability and combinations which conjures up association with football pools. Next month's article will be concerned with putting statistics to work on the computer.


TELEGRAM
URGENT!
DOC SOFT Simulations
"The best simulation around . . . A must for budding pilots" – P.C.N.
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747 and other Doctor Soft programs are available from:
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'747 is no ordinary flight simulator, BBC owners know it as the program that topped the BBC charts month after month last year.
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yc 7

COMP

Get on board for our high-flying July competition.



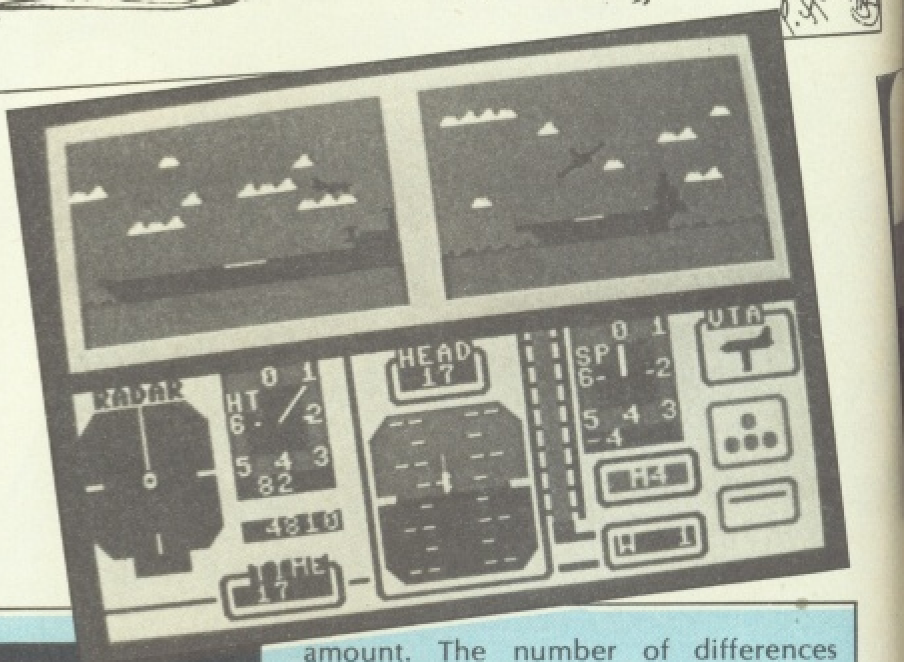
DA, DA, DA, DA, DA-DA, DA, DA...NO, your ears aren't deceiving you, these are the first few notes of the nattiest flying tune of all time – the Dambusters Theme Music – a very noble lead-in to Jump Jet, Anirog's follow-up to their ultra-successful, Flight Path 737.

Jump Jet for the Commodore 64 is due for release at the end of May. It will retail for £9.95 on cassette and £11.95 on disc. Forty lucky prize-winners will be able to simulate mayhem in the living room if they're first out of the bag with the correct answers to our competition. And, one even-luckier-than-lucky prize winner will not only win a copy of Jump Jet but will be able to scribble to their heart's content with a copy of Anirog's Super Sketch (valued at £49.95 – see last month's issue for our ace review). More of how to become such a lucky person, later on.

Jump Jet is a combat and flight simulator, written by Vaughan Dow who, for many years, was a Jump Jet pilot. It starts by leaving you all at sea as you take off from the landing deck of a carrier. Using a variety of instruments on your dash board and your radar screen, you can locate the enemy aircraft. Then it's decision time – should you throw caution to the wind and pursue the enemy or make yourself a laughing stock by returning to the carrier with your tail between your legs. But, even if you successfully attack and destroy the enemy, there is only enough fuel for one journey so you must return to base after each mission.

This is Jump Jet in a nutshell. The skill levels reflect the ranks in the RAF – Flight Lieutenant, Squadron Leader, Wing Commander, Group Captain. One definite plus is the use of sound to relay messages – for example, 'Ready for take-off' 'Enemy contact' or 'Low fuel' – especially handy for those who can't read.

For those who missed out on last month's issue (*back issues available from this office – ed.*) Super Sketch is a drawing tablet accompanied by some excellent software and, in our reviewer's opinion, is 'excellent value and great fun'. It retails for £49.95 on cassette and £51.95 on disc.



How to enter

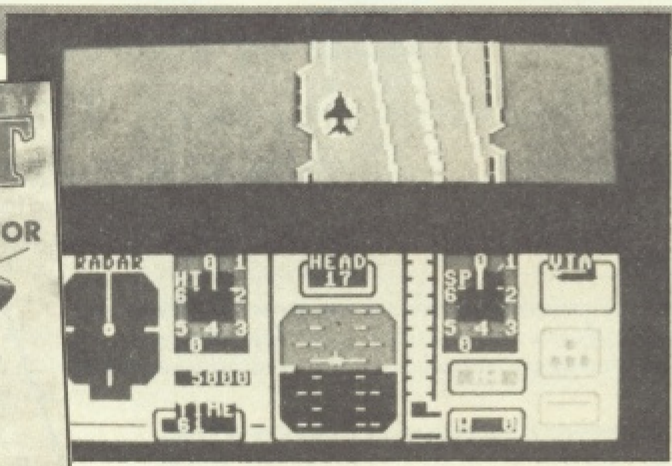
Study the pics of our very own Air-Commodore (for the uninformed amongst you, that's the rank above group captain in the air force). Now, even if you are not bright enough to realise that the word Commodore refers to anything other than a computer or a Lionel Richie clone, you can't fail to notice that there are several differences between our two pictures. But how many? You tell us. Just circle the differences on the picture on the entry coupon and jot down the amount. The number of differences should also be written on the back of the envelope in which you send your entry otherwise we will not be able to accept it.

You may enter as many times as you wish but each entry must be on an official coupon and sealed in a separate envelope Please write clearly on the coupon as it will be used as a label if you win a prize.

Fill in your answers, name and address on the entry coupon and send it to Anirog Competition, Your Commodore, 1 Golden Square, London W1R 3AB. The closing date for the competition is 31st July.

PETITION



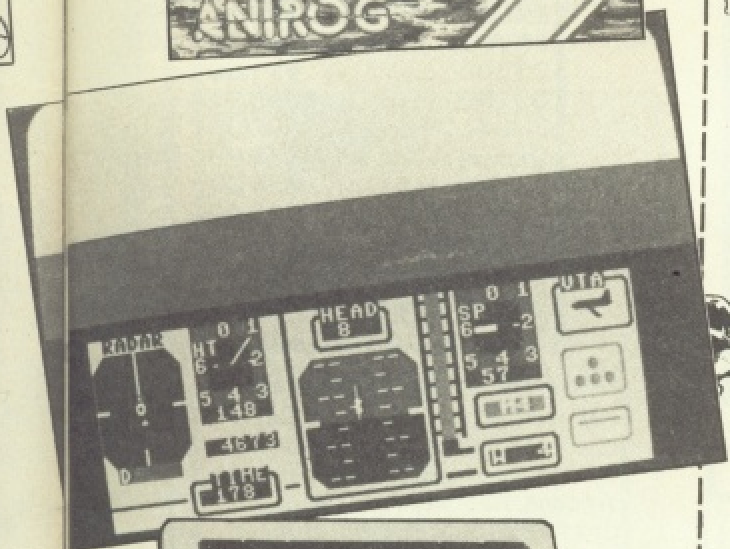


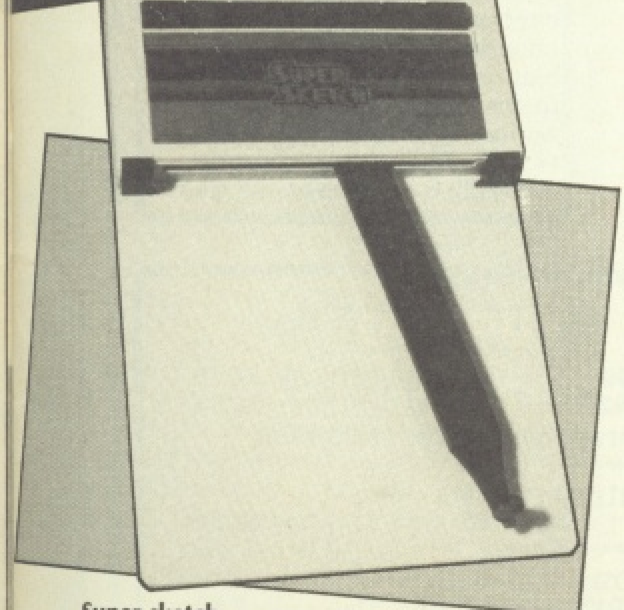
The Rules

Entries will not be accepted from employees of Argus Specialist Publications Ltd, their printers and distributors, and Anirog Software. The restriction also applies to employees' families and agents of the companies.

No correspondence will be entered into with regard to the competition results and it is a condition of entry that the editor's decision is final.

The How to Enter section forms part of the rules.





Super sketch



Anirog Competition

I'm...

Fly me from ....

....

.... Postcode......

To the Your Commodore post-bag.

I spotted .... differences.

Remember to write your answer on the back of the envelope or your entry will be invalid.

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	CASS	DISK
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We also supply a range of dust covers, daisy wheels and other ribbons

INPUT

Agony uncle, John Donovan, solves more problems and heartaches.

INPUT

I am having great difficulty in obtaining a printer for my Commodore system. I already have the 4207 Tractor printer but wish to obtain a printer of 'letter-quality' output. It would also be nice if it could take both continuous and separate sheet stationery. The present system comprises a Commodore 8032 micro, 8050 dual disc drive and 4022 Tractor printer (dot matrix).

I would be grateful if you could advise me on the type of printer to use (other than Commodore) and any interfacing required.
A. K. Moyce
Southampton

OUTPUT

I suggest you use a printer interface such as the Panda variety marketed by Pact International. This done, if you really want letter-quality you will need a daisy wheel or printer, but these are expensive. You could try either the Star SG-15 or the SG-10. Also, take a peek at our Business Bonanza.

INPUT

I bought my 64 to help pass the time during my retirement and I now have a collection of software on cassettes. I am also attending evening classes in BASIC programming. I have recently acquired a 1541 disc drive and would like to transfer all my software onto disc to obviate the delay in loading the programs.

Can you recommend any commercial software which would enable me to do this?

Some time ago, I plugged in a games cartridge whilst the 64 was switched on. The cartridge is now corrupt and unusable. Is it also possible to have a back-up copy of a cartridge program transferred to disc so I don't make such an expensive mistake again? Can the cartridge be re-programmed.
B. Muncaster
Eastleigh

OUTPUT

Yes, it is possible to transfer software from cassette to disc but, unfortunately, some naughty people use this process for piracy and, therefore, I cannot disclose any details. The transference of cartridge software is also possible but, for the same reasons, I cannot give you any further information.

INPUT

How do I save to disc a program whichis 18 parts long with each part of the program having the same line numbers and with the last line of the previous part loading the next part. I have tried several ways of doing this such as using 18 different tracks but nothing seems to work.
John B. Tomlinson
London

OUTPUT

Change each load statement to LOAD "xxx",8 (ie, LOAD "Part 2" at the end of Part 1) and...hey presto, your prayers are answered!

INPUT

I have a Commodore 64 and wish to key in programs. Unfortunately, a lot of programs have single RETURN statements on a line and I find that my computer keeps throwing up the syntax error RETURN WITHOUT GOSUB.

Can you please tell me how to correct these programs.
R. Hills
Folkstone

OUTPUT

There is some confusion here. There is no error in placing a single RETURN on a line. The error message means that a line containing a GOSUB has been omitted earlier on.

INPUT

In response to Mark Jones' letter (Input/Output, May – 'sluggish 1541'), anyone using a 1541 disc drive can now load most software four times faster using Trigsoft's GT LOADER CARTRIDGE. It costs £20.00 inc. p&p and features abbreviated load and save commands, the ability to display the disc drive directory on the screen without erasing programs in memory, an on/off switch so there's no need to unplug it in case of a conflict and a reset switch.
G Kelly
Trigsoft

OUTPUT

Anyone who agrees that the 1541 induces comatose may contact Trigsoft at:
161-163 Rutland Street,
Grimsby,
South Humberside,
DN32 7ND.

INPUT

I have been asked by a friend to take a Commodore disc drive and software back with me to New Zealand. I am concerned that British hardware and software may not work with Commodore machines over there. Although the power supply is the same, I know that TV sets use different frequencies and so British computers cannot be hooked up to a New Zealand television set as a monitor. Can you tell me whether the same is true of disc drives and software.
Lyall Evans
London

OUTPUT

If the power supplies are the same then you are OK with the disc drive. As far as software is concerned, most of ours comes from the States, so there should be no problem.

INPUT

In your January issue, you answered a query from Jim Watts in Portsmouth, about a PET. You replied that you cannot get auto repeat on all of the keys. You can. There are 2 machine code routines for BASICs 1 and 2 (BASIC 4 has a repeat key) published in Raeto West's book 'Programming the PET/CBM' (page 258).

By the way, apart from the information you gave in your reply, POKE 227,0 is a good way of disabling or turning off the keyboard within a program to stop itchy fingers filling the keyboard buffer with 'garbage' whilst processing takes place.
Tom Ryan
Manchester

OUTPUT

Well, I suggest that all readers with similar problems set their 'itchy fingers' loose over Mr. West's book — it's a good 'un!

OUTPUT

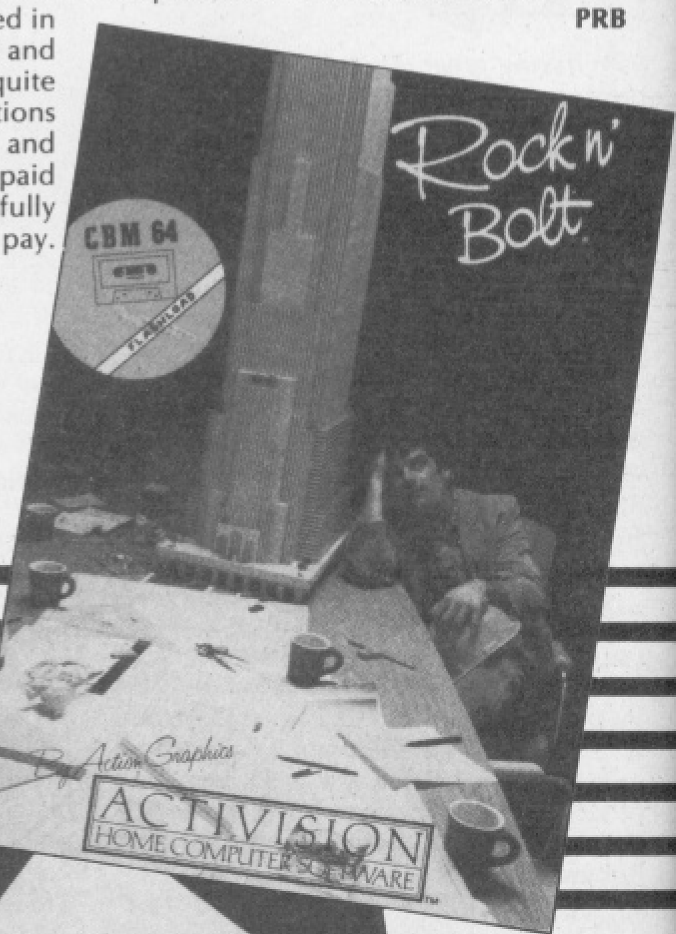
Our reviewers pass judgement on the latest software gems found lurking on the editor's desk.

Rock'n'bolt
★ ★ ★ ★ ★
Activision
£10.99 (cassette)/£19.99 (disc)
CBM 64 — Joystick essential

AT LAST – AN ORIGINAL GAME WHICH requires you to use your brain, and not just your trigger-finger. The task is to bolt girders together for each of 100 floors of a new skyscraper. They do not form a simple grid, but each floor has a complicated layout filling up to three screens. The girders move around as if swinging from the jib of a crane, and you need to jump about, then bolt them down in the correct positions. At this point you find yourself cut off (in your prime) so you need to undo several bolts and think again! The girders have to be fastened in the right order to get back to the lift and the next floor, and while this alone is quite an exercise in logic, there are two options where you are set against the clock, and these are really challenging! You are paid for the number of bolts successfully fastened, and your score is the total pay. The game has excellent 3D graphics with very smooth animation, and is accompanied by a good rock soundtrack.

If you like slaughtering everything in sight this game is not for you. If, however, you are intrigued by the idea of a sort of computerised Meccano, then it is quite exceptional and not to be missed!

PRB



Software Spotlight



Grand Larceny
★ ★ ★ ★
Melbourne House
£7.95
CBM 64 (joystick optional)

DASHED CLEVER, THESE MELbourne House chappies. Just as The Hobbit begins to become a fading memory, blow me, they come out with yet another, excellent adventure game which sets the pace for others to follow.

Grand Larceny is set on the layout of a hotel (the Grand) the object being, first of all, to get into the place and secondly, to get out again having recovered stolen plans before your time runs out. The screen is divided in three: the top part shows the adventurer and his immediate surroundings, the middle screen contains a textual description of the location and describes any special objects to be found, and a command entry window occupies the bottom part of the screen. Your hero walks at variable speed with joystick or keyboard assistance whilst the locations scroll from left to right across the screen in the graphics window. New vistas open up as doors are opened, stairs are ascended and so on. Detailed descriptions can be called up at any time with the LOOK command and all the exploration is accompanied by a repertoire of well produced sleazy music.

Verbal commands are listed in the cassette inlay and while this removes a lot of the fun of finding the right thing to say this is more than made up for by the variety of movement options and the limited interaction with the other characters in the hotel.

Seasoned adventurers might find the game less of a challenge than they are used to since a good deal of the memory is occupied by the graphics but as a game that offers something a bit different coupled with its own sense of humour it still presents a good package.

The only minor criticism is that there does not appear to be a save option, but since you are presented with a fairly tight time limit within which to accomplish your mission, this is more of a niggle than a nuisance.

RM

Tycoon Tex
★ ★ ★ ★
Gremlin Graphics
£6.95
C16 or Plus/4

TYCOON TEX, WE ARE TOLD, IS A rootin tootin oil tycoon who, surprisingly, spends his time not with Sue-Ellen but running along his pipeline and jumping over breaks in it! Somehow or other this adds a few more millions to his bank balance. He is under frequent attack, but he can shoot back, and gains valuable bonuses from destroying bombs, helicopters and other hazards. At the end of each section of pipe, points are awarded depending on the speed at which it was completed. Another section then begins, with a different setting and new enemies.

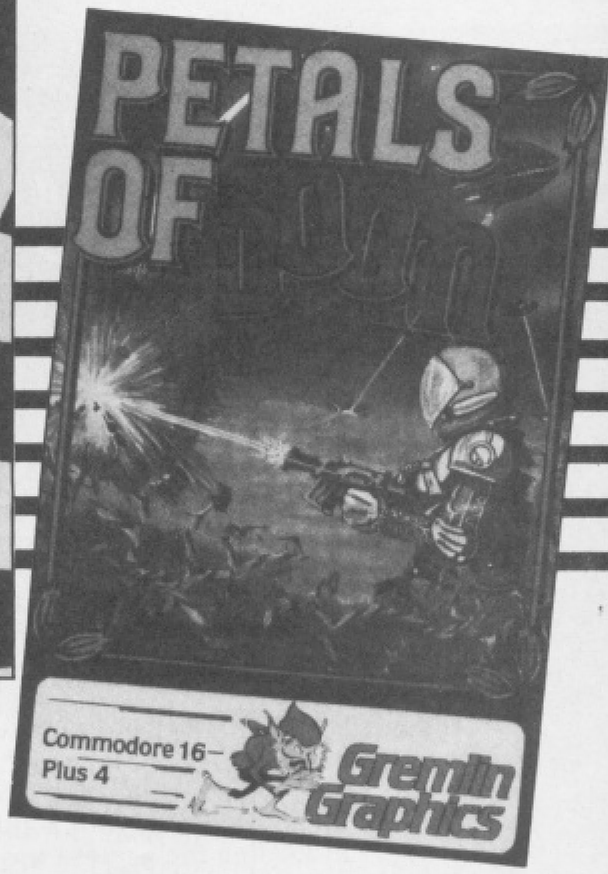
This game owes a good deal to Moon Buggy but it is quite brilliantly programmed, with first-rate scrolling graphics. There are 99 levels in all, with hazards which vary in difficulty from level to level. The title screen gives a high-score table and various options including a demo mode – the whole effect is very professional and impressive.

This is the first game of its type for the C16/Plus 4, and I recommend it highly. By its nature there is not a great deal of variety, but it is a real test of concentration and speed of reaction. So get out your six-gun and follow that pipeline!

PRB







Pole Position
★ ★ ★ ★ ★
US Gold
£9.95
Commodore 64 + joystick

JUST AS THE WELL-HEELED Formula One Grand Prix circus hits the road again with its globe trotting antics, so the runaway success of the arcade halls for the past year or so roars on to the screen. And if you're thinking of running with the pack or even starting in Pole Position, then I'll guarantee that you've made the right choice.

This is a great motor racing game and a superb piece of arcadia. There are three races you can enter, each with a different difficulty level and, of course, a practice run so you can build up your skill. Before you can race you have to go on a qualifying run and claim one of the eight positions on the starting grid. Beat the 73 second time limit and you make the grade to run with the elite; beat 58 seconds and you start from the front of the grid, in pole position. Racing is realistic with extremely clear graphics of both cars and the track. All the car's control functions are operated through the joystick: left and right to steer, forward to accelerate, the fire button to change gear and back to slow down.

Other drivers in the race are both an obstacle and a chance to score points when passed. Off track sign posts can also wreck the car although you do have an unlimited supply of cars to call on within the allotted time. Driving off the track will slow you down considerably and lose you time as will taking the corners too fast as it causes the car to skid. Keep up the test runs and prepare to take the chequered flag. Pole Position is a real winner.

KM

Petals of Doom
★ ★ ★
Gremlin Graphics
£6.95
C16 or Plus/4

GARDEN PESTS ARE A menace, and the varieties found in outer space are the worst kind! Your task is to hunt down and destroy all sorts of alien bugs in 99 plantations of space-flowers. By enabling the five plants in each garden to reach maturity, you may proceed to the next level. There are many kinds of alien insects, each of which moves in a different pattern, and some pose a worse threat than others. On the higher levels the procedure is repeated, but with more bugs to kill. The pests are destroyed by you firing at them, while flying above ground with the aid of a power supply in your back pack. Once your batteries run low you are helpless until they are recharged. You may choose to have up to six lives.

As with other games from Gremlin, the graphics are superb and the use of sound is also good. The game suffers, however, from lack of variety and, although it is fun to play, I suspect that I would tire of it quite quickly. Otherwise it might have merited a fourth star.

PRB

Software Spotlight

Softaid
★ ★ ★ ★
Band Aid Trust
£4.99
CBM 64 (joystick)

THERE CAN BE FEW PEOPLE UNAWARE of the success Band Aid has had in raising money for the people of Ethiopia. Softaid is the computer industry's answer to Bob Geldof, and is a collection of ten top games from some of Britains foremost software houses.

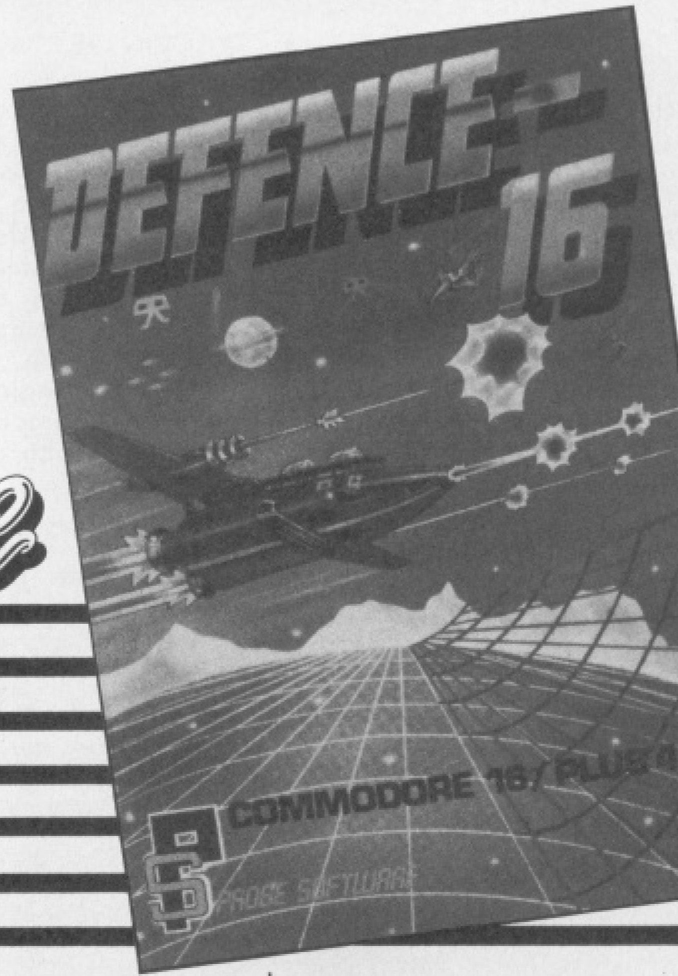
Softaid comes in the usual cassette box with a larger than average inlay card to carry all the games instructions – there is not nearly enough information, but then again there are ten games to cover and you can't get War and Peace onto a postage stamp.

At the start of each side Band Aid have recorded their single. Try not to load this into the 64 as yours truly did; the computer prefers something with a little more bite. On loading the games I was a little dismayed to find that three titles would not load. Even after many attempts I still haven't seen Gumshoe, but one failure can almost be overlooked. Of the other nine there are 4 arcade shoot-em-ups, 2 mazy types, 2 platform/level games and 1 semi-adventure called Star Trader.

None of the titles are particularly new but all are good solid games, no rubbish, and if bought separately each could command an £8.00 price tag and you wouldn't feel cheated. My personal favourite up to now must be Activision's Beamrider, a really good old fashioned joystick basher, and Flak by U.S. Gold. Gilligans Gold and Star Trader also are worth a mention. All the rest deserve a mention as well – this tape is just too good to be true.

Given better instructions, and if all games had loaded, this tape would have received five stars. But still, nobody should be without this compilation.

MTU



Defence-16
★ ★ ★
Probe Software
£7.99
C16 or Plus/4 — Keyboard only

GAMES IN THE STYLE OF DEFENDER have been very popular for other machines, though this is the first I have seen for the C16 – and it's a good one!

This is the ideal game for people with aggressive tendencies, because your task is quite simply to shoot everything in sight. Unfortunately the battle is far from one-sided, – the aliens you are fighting are sneaky, underhand creatures, not averse to such dirty tricks as creeping up on you from behind or homing in on the heat from your engines. This means that as well as shooting you need to dodge, and this is made more difficult by the mountainous terrain over which you are flying. Not surprisingly, hitting a mountain is just as fatal as mid-air collisions with Swarmers, Landers or Zaks!

The sound effects are very good and the graphics, though not outstanding, are reasonable. The game really loses out, however, by having no joystick option. No fewer than seven keys are used to control your craft, so after a while your fingers turn into stocking-stitch!

Persevere, though, as the game is well-programmed and worth buying.

PRB

Las Vegas
★ ★
Anirog
£6.95
CBM 64, VIC 20 & C16

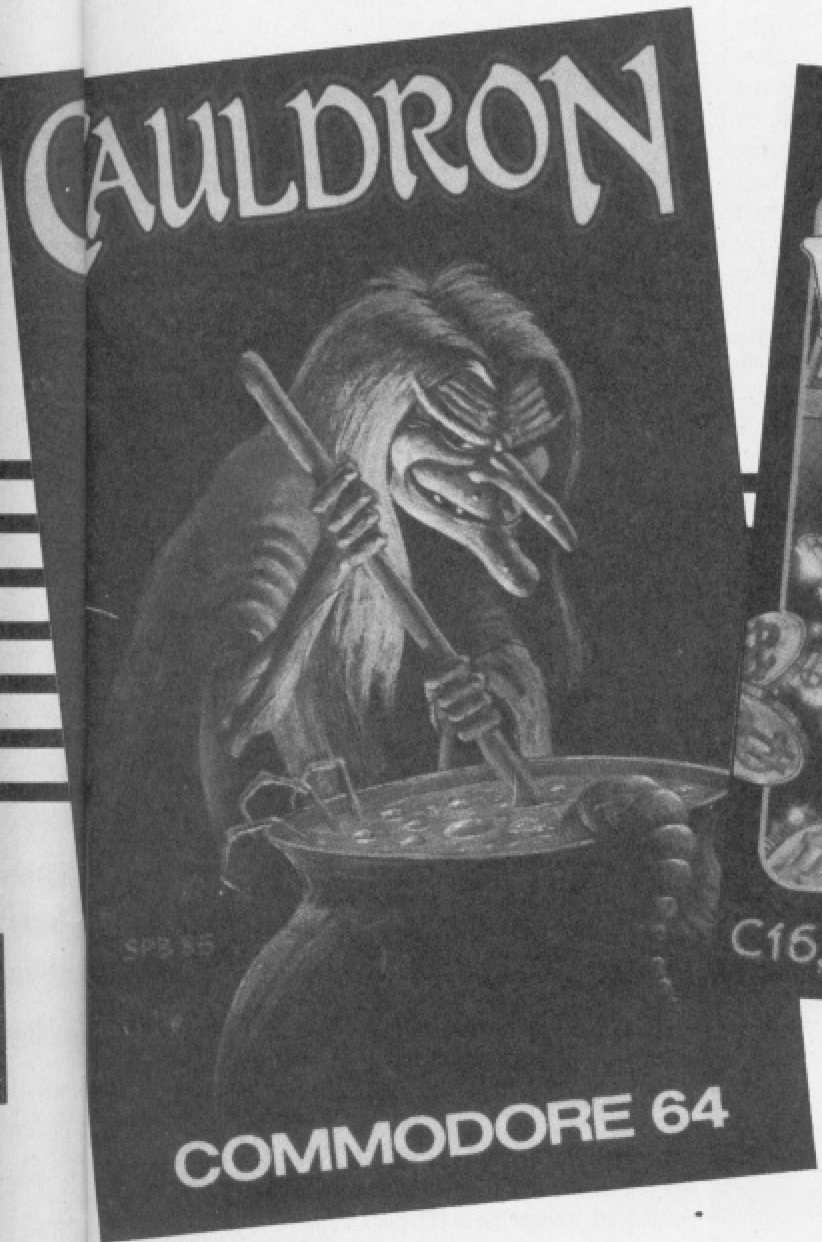
TO BE HONEST I DON'T SEE THE POINT of computerised fruit machines. It's just not the same as playing the real thing and you don't get the sense of actually gambling anything. Having said this Anirog's game is quite playable and there are three versions, one for each computer, on the one tape. Each includes a fast and reliable turboload.

The C64 version's graphics aren't amazing – the reels take up a small part of the left side of the screen, and the rest of the screen is covered in a large number feature grid which has loads of complicated features which flash if you get a certain combination.

The VIC version graphics are bigger, taking up nearly half of the screen, but it doesn't include all the C64's extra features, having just hold, nudge and gamble. Some of the fruits have numbers, and if enough of these appear on the win line you gain nudges or other 'features'. I found the instructions misleading and in some cases wrong.

Las Vegas claims to give you all the excitement of a casino. It doesn't but if you want a fruit machine it would be worth getting.

PRB





Cauldron

★ ★ ★ ★
Palace Software
£9.95
CBM 64 + Joystick

THE CASSETTE INLAY OF Cauldron will convince most people that this outing, in which you pilot a witch on her broomstick, should be added to their collection. The inlay's graphics look good and, just for a change, the screen graphics are, if anything, even better.

The game could have done with a few more instructions, though the publishers obviously do not wish to give too much away in this arcade 'adventure', with various screens requiring a touch of trial and error to discover just what artefacts should be snaffled. During the first few plays, a lot of the time was spent finding out how to get about far less start on the quest.

The joystick guides a witch about on her broomstick over a moonlit landscape of forest, lakes, volcanoes and mysterious doors. Spells can be hurled at naughty ghosts and vampires and other inhabitants of the netherworld. Collisions with these spirits drain your magic but this can be replenished at the local magic stations resembling November 5th sparklers. Various doors become apparent as you journey with the witch on her quest through this Hallowe'en landscape and the object, as far as I could surmise, is to land on the ground (a difficult task in itself) and collect keys with which to unlock the doors to subterranean haunts wherein toads, newts and other horrors could be found to increase the witch's power. Cauldron is superficially an original game but on the few occasions when I did succeed in reaching the caverns of molten lava behind those locked doors there was more than a hint of platforms in the air.

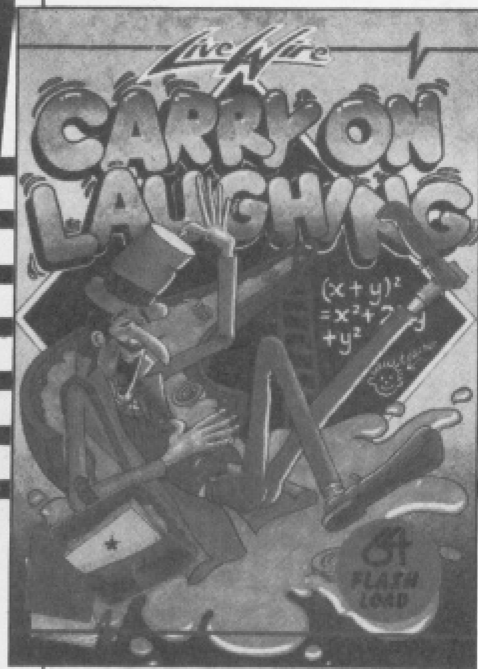
Despite the lack of instructions the game is well produced and is not of the "play once and shelve it" variety. Sounds very good but nothing special. High scores as far as could be ascertained or achieved were not catered for but graphically the game takes full advantage of the 64.

RM

Carry on Laughing

★ ★
Live Wire
£6.95
Commodore 64

CARRY ON LAUGHING? I very nearly split my sides! But then perhaps I am getting just a bit too cynical in my old age although there is no hiding the fact that this is not exactly the



best piece of software to come from the Live Wire stable. Feast or famine I suppose, so roll on Christmas. Anyway on with the review.

It comes as no surprise that you are in control of Mr Live Wire himself. He gets around a bit does Mr Live Wire and this time he is the caretaker at St. Hexadecimals an infamous school for demented computer programmers. Apparently he's getting into a bit of a fix trying to tidy up all the classrooms starting with the dining room and moving on through the biology room, the chemistry lab and braving it all in the computer room. When it comes right down to it this is little more than a fairly basic platform and lifts game with a number of objectives to achieve and obstacles to avoid.

With only three lives in reserve the going is fairly tough. But when the going is tough, the tough get going and doubtless you will succeed in turning the crosses liberally dotted around the screen into ticks. There, I knew I could finish on a positive note.

KM

Software Spotlight

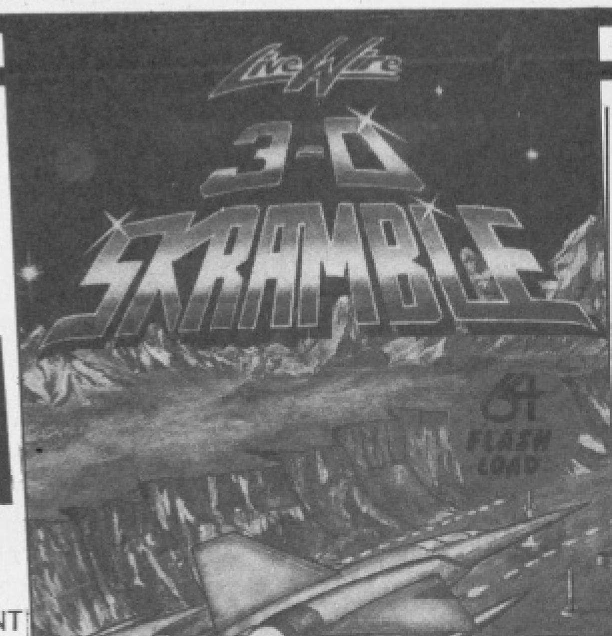
Major Blink

★ ★ ★ ★
CRL
£6.95
C16

THIS GAME USES A PAINTER TYPE scenario – you must guide Major Blink about a maze of passages painting the areas between the paths by moving around the area. As each area is painted, you gain points. Inevitably life isn't that simple and two sets of nasties try to get you. Firstly, colour blind bears move down the screen reversing the painted areas. You can shoot these bears but, of course, they keep coming. Secondly, the maze is inhabited by homing drones which endeavour to catch the Major but which can be temporarily disabled by shooting them. The top portion of the screen is a safe zone and no bears will appear whilst you're in this area. Clear the screen and move on to the next.

The game makes full use of the C16's colour capabilities and is bright and and very pretty. The design and animation of the figures are neat and effective. Both keyboard and joystick options are available but, for success, a joystick is necessary. The game is both testing, addictive and great fun to play. In view of the memory limitations of the machine, this is an effective game and worth a try.

A.W.



3D-Skramble

★ ★
Livewire Software
£6.95
CBM 64 (joystick)

HANDS UP ALL THOSE WHO WANT another version of Scramble. Come on there must be someone. What if I said it was in magnificent 3D perspective? That's slightly better – you're in luck because Livewire Software has just released 3D-Skramble for the 64.

3D-Skramble, as a re-hash of the old arcade favourite we all know and love, has you flying through the same old caverns, a city, flying saucers and a storm of fireballs. At your defence are the mandatory lasers and to stay in the air you must bomb the enemy fuel dumps.

On powering up you are given the option of one or two player mode, you can select any one of ten skill levels and play from either keyboard or joystick – advise the latter, it's far easier. 3D graphics take a little getting used to; to me they looked lumpy and pretty crude. Even the fighter bomber you control is pretty chunky and responds too slowly to the joystick for my liking. In it's favour, there is good use of colour, but the really outstanding feature of this rather ordinary game is the music. A really stirring rendition of 633 Squadron plays throughout (but can be turned off). If only the game was of the same standard as the music all would be well.

Overall this game was a bit of a let-down. There are variants of scramble available, albeit not in 3D, which play better. Not even the soundtrack can get this offering more than two stars – the music deserves a better game.

M.T.U.

Out on a Limb

★ ★ ★ ★
Anirog
£6.95
C16 or Plus/4 – Joystick optional

SO JACK SWAPPED HIS MOTHER'S COW for a bean seed and, far from being grateful, she threw it from the window in a temper!

The game starts with Jack leaping from branch to branch to climb the beanstalk, after which he hops through the clouds and enters the giant's castle. It all sounds very simple, but the beanstalk, the clouds and the castle are infested with weird creatures, whose touch is invariably fatal. These come in many guises, including manic ducks, killer jelly-babies and demon Hoovers, and these are not easy to avoid. Once in the castle there are 23 rooms to explore, with the eventual aim of finding treasures: a golden egg, a harp and a bag of gold.

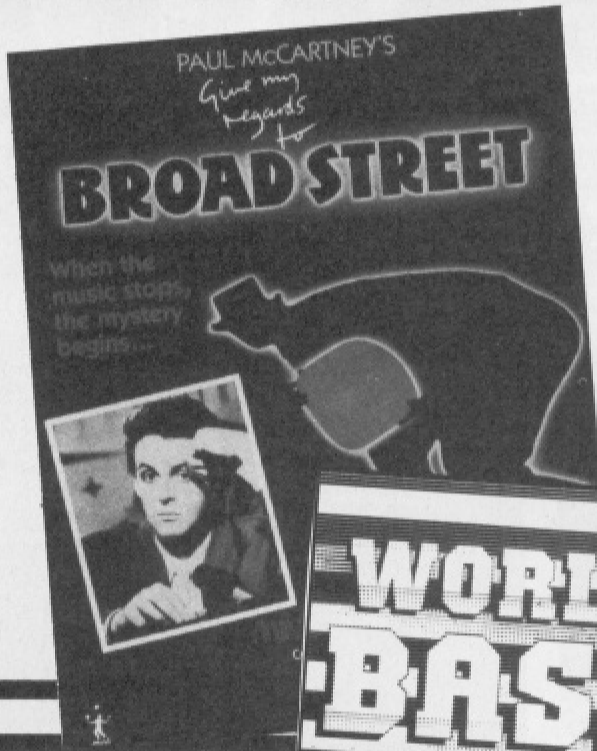
Basically this is a platform game, but it scores for its size and sheet quality! On completing one section of the game, the next loads – there are three parts in all, occupying well over 16K. No score is kept as the aim is to get as far as possible in the shortest time – the time elapsed is displayed throughout. The graphics are excellent, though inclined to flicker, and the sound effects are good.

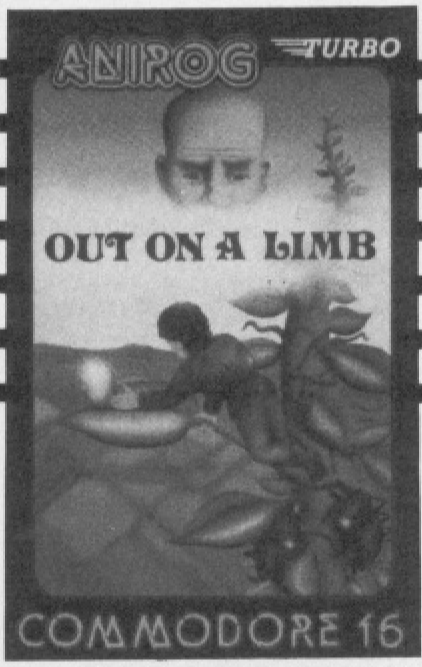
A very interesting, challenging game – highly recommended!

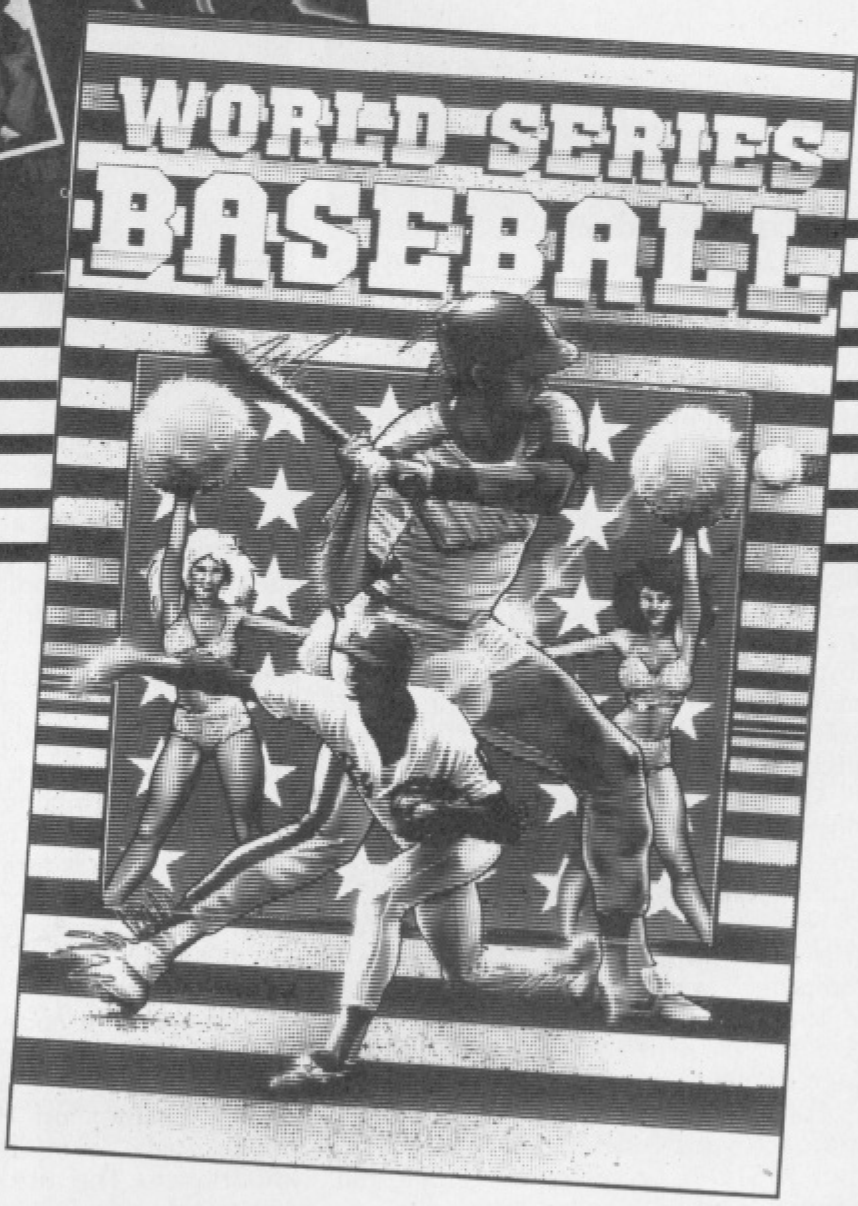
PRB

Give my regards to Broad Street
★ ★ ★ ★
Arugs Press Software Group
£7.95
CBM 64 and joystick

HAVE YOU EVER WANTED TO BE A TAXI driver in central London? If so a good knowledge of the area's transport system, together with a photographic memory and some experience of human nature would be invaluable. Coincidentally these are also the attributes you need if you are to play Broad Street with any chance of success.







You take the part of Paul McCartney in search of a missing album track, pieces of which are in possession of various of your friends. Unfortunately it is a Saturday and your friends are scattered all over London doing whatever they do at weekends. However being friends, you have a good idea of their interests and habits and as they travel exclusively on the underground you need only to be at the relevant station as they leave for them to give you their piece of the song.

To aid you, your car is equipped with a computer linked to the central transport system which informs you of their whereabouts. Using this information together with a road map of the area, you make an inspired guess as to their destination and tear across the city in pursuit – avoiding traffic wardens and lunatic drivers – accompanied by a spirited rendering of Band on the Run. There are ten pieces of the song, all of which must be found between 9.00 am and midnight.

The program is a refreshing variation on the maze-type game with good use of Hi-res graphics, sprites and colour. I found it very demanding and highly enjoyable.

DJT

World Series Baseball
★ ★ ★
Imagine
£7.95
CBM 64 — 1 or 2 joysticks

BEING A GREAT CHARLIE BROWN FAN, I sat down enthusiastically to play this computer version of the American national sport. I soon discovered, though, that I am a player even Charlie Brown's team could beat!

Graphically this game is superb! You are presented with a picture of a baseball stadium as seen from behind home base, complete with fluttering flags and a crowd of spectators. A large screen at the back gives information and a close-up of the action. All control is by joystick, with the joystick serving a variety of functions at different times. This is rather involved, but logical once you get the hang of it. All the features of the real game are included, even down to a troupe of cheerleaders who appear between innings!

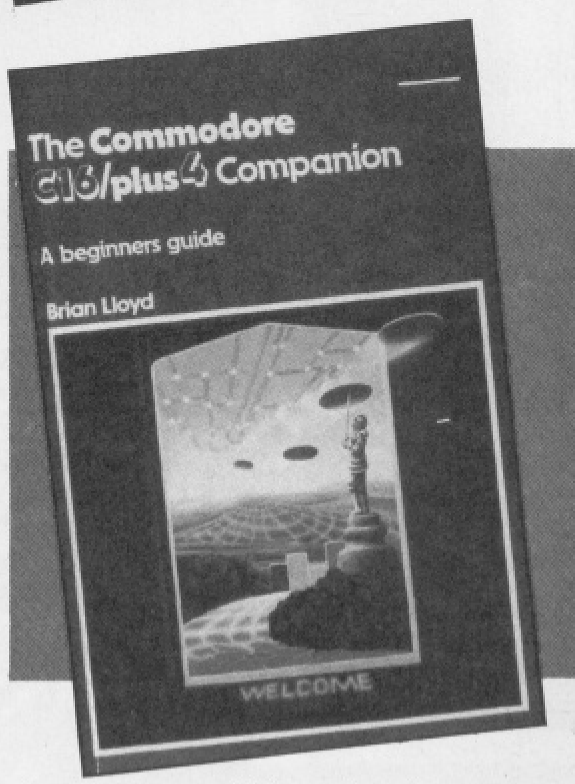
I found the game excellent for two players, but control is so complicated that playing against the computer leads inevitably to humiliating defeat! There are other criticisms too – the ball is very difficult to hit, and the fielder who responds is not always the one you might expect.

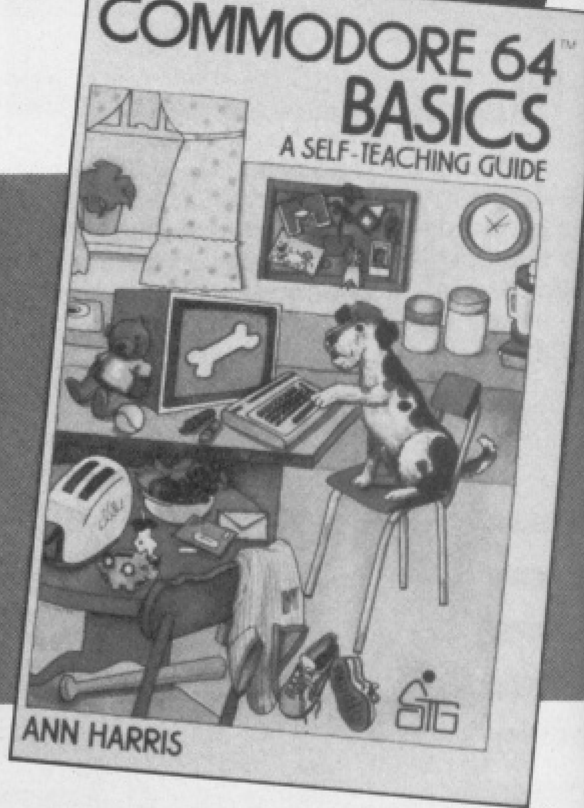
On the whole, however, it is well-programmed and I can recommend it, provided you can find two joysticks and a human opponent!

PRB

REFERENCE

A bumper book section, this month, includes a look at one of the C16 books hitting the market.





Title:
The Commodore C16/Plus 4 Companion
Author:
Brian Lloyd
Publisher:
Sunshine Books
Price:
£5.95

COMMODORE'S LONG-ESTABLISHED reputation for producing poor documentation lives on, long after the quality has been substantially improved. Thus, many books have been produced with the advent of new machines. The C16 and Plus/4 offer two major advantages to the publisher and author. Firstly the operating systems are identical on the two machines, except for memory size and, in the case of the Plus/4, the built-in software. Secondly, there is a potentially large market, on the one hand for the absolute beginner, and on the other hand, for the businessman or business-woman who wishes to start to make effective use of the machine.

The author has totally ignored the Plus/4's built in software, which is an amazing omission, even for a book containing only 161 pages.

Noting that the author is highly knowledgable about the Dragon computer, we become curious as to whether he knows as much as he should about Commodore machines. Regrettably it appears not.

For a start, I am not impressed with an approach which includes READ, DATA, and RESTORE commands under the heading 'More Advanced Programming'. They are amongst the easiest commands to understand, and are frequently the group with which beginners become acquainted, as soon as they have overcome the excitement of printing out their name on the screen.

Similarly, the use of the world 'Initialise' in the context of HEADERING a disc is likely to cause confusion amongst Commodore users. To such users this expression has always meant reading the Directory and Block Allocation Map into the RAM of the disc drive. To have the meaning suddenly changed to cover the destruction of the contents of the disc is dangerous.

The resumé on the back cover suggests that after reading the book, you should be proficient in the more sophisticated programming techniques such as disc file handling. This overstates the case. Any disc drive likely to be used with this machine will have Relative Record Files available for random access: there is no mention of this in the book.

The Chapter called 'Structuring your Programs' contains no discussion on how to do that. It contains some information about commands creating program structures such as loops, but DO WHILE and DO UNTIL are not covered, whereas FOR NEXT is. The section in this chapter on LOADing and SAVEing programs belongs elsewhere.

The Machine code chapter is only a run through the commands included in the built in MONITOR.

The chapter on Peripherals glosses dangerously over matters of some importance. The use of the COLLECT command to deal with improperly closed files is covered, but you are not told how to identify such files (by the asterisk appearing on the directory). Similarly, it is suggested that the COPY and BACKUP commands are usable if you have more than one disc drive. This is true enough, but only if those two drives are accommodated in a single disc unit. The distinction is important, and is made clear in Commodore's own documentation!

Flawed though it is, this book is written in a more chatty style than Commodore's own documentation, and is therefore considerably easier to understand. However, you would be better advised to wait for books written by more experienced Commodore hands, like Raeto West and Peter Gerrard.

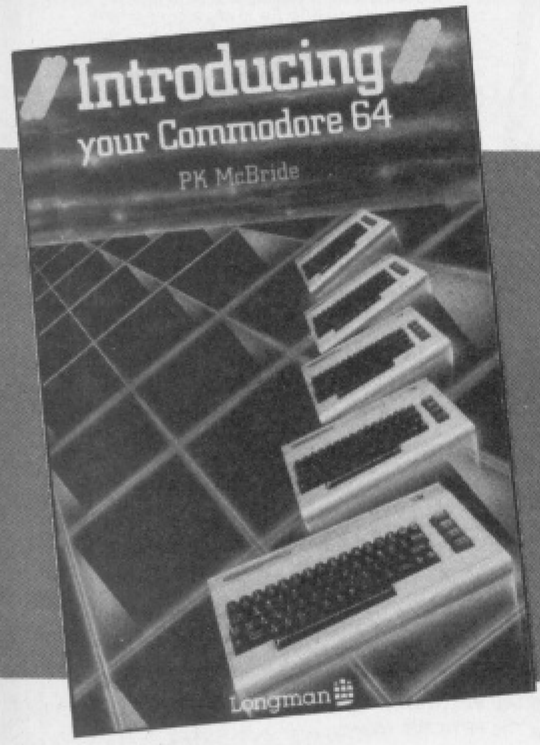
Title:
Commodore 64 Basics – A self-teaching guide.
Author:
Ann Harris
Publishers:
Wiley Press
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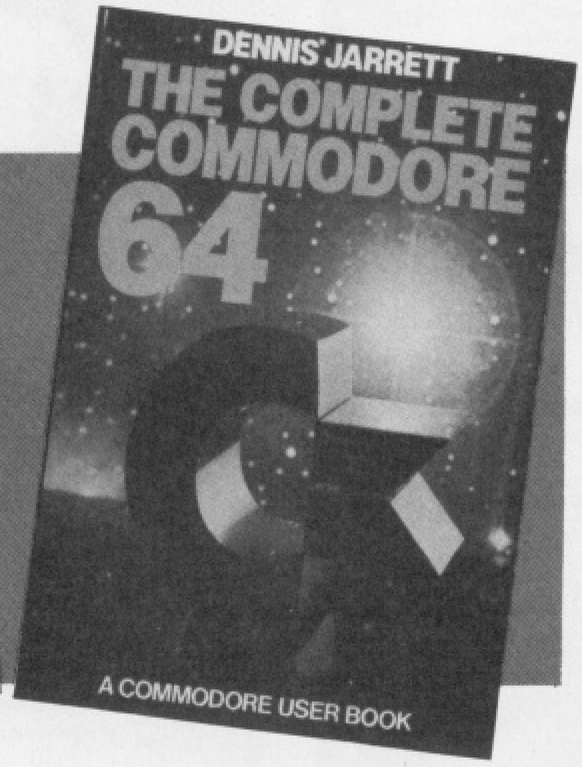
IT'S ALL VERY NICE ANSWERING THE call to join the high-tech generation and buy a computer, but it's rather difficult to learn to program a computer well if you have absolutely no previous experience. Once you've learnt a langugage, it's almost trivial to learn a new language or move onto a new machine. It's for these reasons that I enjoy reading good quality teaching books, such as this one, which ahcieve what they claim.

In true American traditions, this book reinforces the information given by providing occasional questions for the reader to answer. This wasn't really my cup of tea, but it does work.

The book sets out to teach you the use of BASIC and give a feel for graphics, sound and data handling. The approach to this problem is to tackle the material in small pieces. The preliminary section deals with the hardware and how to interconnect it. For owners of disc drives, the commands are described in a simple manner. To get you going, simple one line programs are introduced along with how to save and load your creations. The philosophy is simply to help you gain confidence by using the computer. Once

LIBRARY





you realise that you cannot hurt the machine, it's surprising how easy it is to use.

Making progress beyond this point takes some work, so the concepts of flowsheets and algorithms are introduced. Subsequent programs in the book use flowsheets, demonstrating their worth, and the more advanced concepts such as decisions and looping are discussed with examples of their use and value. The section on programming is completed with a listing for a simple database program using sequential files. While this is probably a good idea for the States where disc drives are common, it isn't for the UK. This aside, it is a useful example of how to write such a program. The remainder of the book discusses simple graphics, sprites and sound. Whilst these subjects aren't covered in great depth, it's a tolerable effort.

On the whole this is a detailed and enjoyable book which teaches the subject of programming in a simple but effective manner.

Title:
Introducing your Commodore 64
Author:
P. K. McBride
Publishers:
Longman
Price: £3.95

ACTION PACKED PROGRAMS, NEW Programming Skills – such is the blurb on the cover of this book, from which one might assume that here we have a new approach to BASIC; in actual fact this book is full of everything that has been published *ad infinitum* while the approach is directed towards those of limited intelligence. A lot of space is filled with cartoons, flashy designs and inane comments.

Quote: How do you make tea? Work it out step by step and write it all down. This is your tea-making program: unquote. Get the message?

The contents of the book cover a variety of subjects including the inevitable user defined graphics, sprites and sound; the ADVANCED BASIC section is rather retarded; not my cup of tea (ouch!).

The best that can be said is that all the programs are functional.

E.M.

Title:
The Complete Commodore 64
Author:
Dennis Jarrett
Publishers:
Hutchinson Computer Publishing Company Limited,
Price:
£7.95

THE CLAIM FOR THIS BOOK IS THAT IT could be the only 64 book you'll ever need. I doubt it this is true but as an overview of the Commodore 64 system it is undoubtably an excellent reference manual.

The book is presented in a lively manner with each chapter divided into smaller sections, thus making it not only a good, easy read but also a suitable candidate for browsing through in idle moments.

It opens with a level-headed appraisal of the 64 which, though obviously favourable, does not ignore its weaknesses such as rudimentary BASIC and non-standard RS232. This is followed by a potted history of Commodore computers prior to the introduction of the 64 and has an excellent section on Commodore's tantalising projects after the 64 up to the introduction of the Plus/4 and C-16.

At this point the book launches into a clear, concise description of how to set up the machine, finding your way around the keyboard and making the first steps in programming. This last section includes lots of short routines to demonstrate the use of the BASIC reserved words within a program structure.

The sound and graphics functions appear in latter part of this section but the explanations lose none of the crispness of the earlier sections dealing with the relatively easier commands.

The third major section deals with peripherals, after an initial introduction to filing systems. Cassette recorders, disc drives, and printers are all dealt with in a fair amount of detail, giving a far clearer understanding of each unit than you get from their individual manuals.

Unfortunately, there is a serious omission in this section. The 1520 plotter/printer is dealt with very sketchily and the text misleadingly implies that the same commands can be used as for the Commodore dot matrix printers, simply by using the device number 6 instead of 4. This not only underestimates the capabilities of the 1520 but is also incorrect in most cases.

The section on business applications takes a long look at the types of software available with sound advice on choosing the correct package for your own circumstances.

A brief look at the facilities of the SX-64 portable closes this section and leads on to a miscellany of error message types, useful memory POKEs, a glossary and bibliography, finally ending with a summary of the available BASIC keywords and a useful memory map.

The Complete Commodore 64 is definitely a must for the relative newcomer to the machine but offers little more for the experienced user and if, as the cover claims, it could be the only 64 book you'll ever need then why bother with a bibliography. The bibliography is obviously a mere cursory glance at the kind of publication available for the 64 – after all, in the section on magazines, a glaring omission is that most essential magazine for 64 owners: Your Commodore!

Get more from your Commodore 64

The Commodore 64 Kernal and Hardware Revealed

Nick Hampshire

A knowledge of the Commodore 64 kernal software and the hardware with which it interacts is essential for all programmers wishing to make full use of the machine's capabilities. A thorough knowledge of the kernal software will give the programmer a wealth of ideas and methods for exciting programming techniques.

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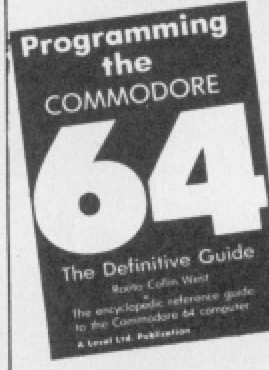
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COMMODORE 64 OWNERS
The Ultimate Reference Book



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Biz-whiz, Dave Crisp, casts his beady eye over the best of Business software and hardware for the 64.

BUSINESS BONANZA

The Silicon word

WORD PROCESSING IS PROBABLY THE most common serious application for the home computer. At some time, most people want to prepare a well designed and clear letter. The word processor allows you to do this with ease. It also enables you to amend errors before printing the finished letter.

To see or not to see

There are two basic types of word-processing: pre-formatted and post-formatted. A pre-formatted word processor shows the document on the screen as it will be printed (with a few exceptions) while, with the post-formatted type, the document does not appear as it will be printed but has certain characters which indicate what will happen to the text. Most post-formatted word processors have a preview facility which allows you to see what the letter will really look like when printed.

Top of the form

Vizawrite, to me, is almost perfection. It only lacks an 80 column screen (a limitation of the 64, of course). It is easy to use and all of the important functions such as word wrap, mail merge, tabulation, decimal tab and so on are there. All the keypresses to format and so on are logical and easy to remember; except for mail merge and file transportation a manual is almost unnecessary. Some of the most impressive features are:

- the facility to input a new format line at any time throughout the document. For example, you can insert new tab stops if the style of the letter changes.
- the delete text function. If you press the Commodore key and delete key and move the cursor over the text to be deleted, the text changes to white. To insert text you then press the Commodore key and insert, and the following text shifts down. You can now type an unlimited amount of text between existing text.

Printout

It is vital to receive hardcopy of what you see on the screen, although some packages tend to overlook this. Vizawrite includes all sorts of built-in interfaces which should make it compatible with most printers.

It employs a very effective method to make the most of your printer's extra functions. If your printer uses odd codes to produce such things as italics, sub-

Viza Software 9 Mansion Row
Brompton
Gillingham
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Tel: 0634 813780

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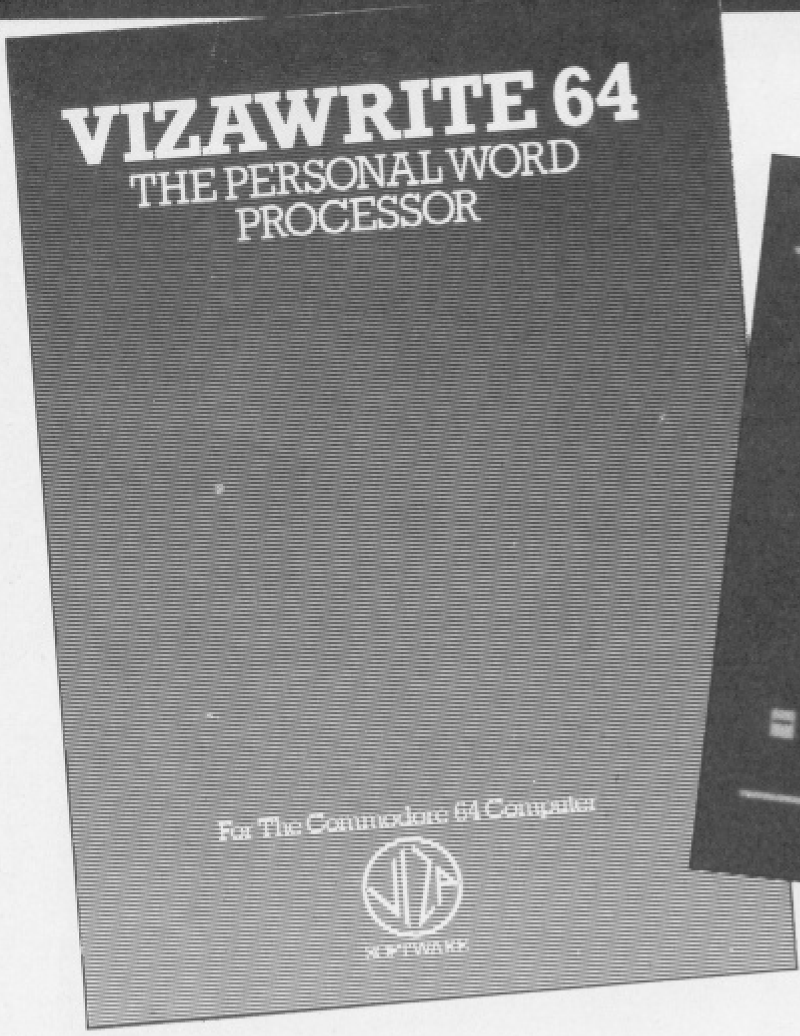
Easyscript	**disc**	**£75.00**
Easyspell	**disc**	**£50.00**

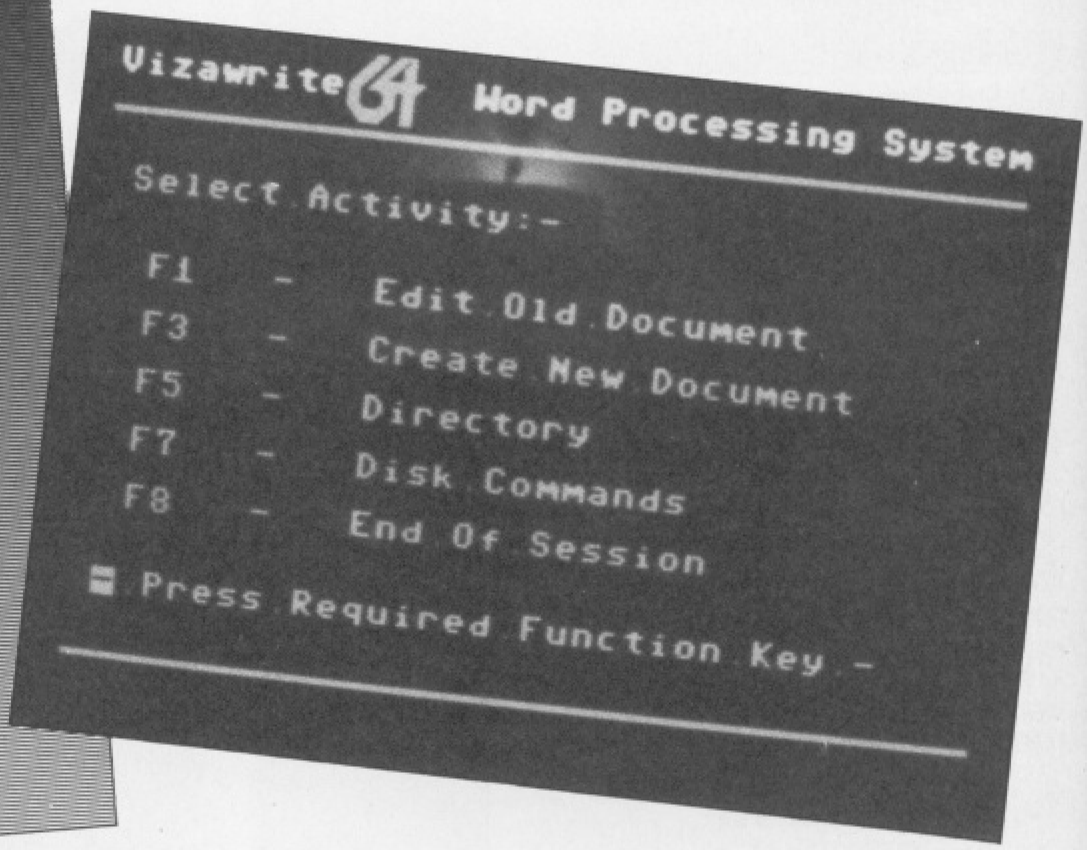
Simple Software

Simply Write	**disc**	**£46.00**
Simply Write	**cassette**	**£40.00**

Audiogenic
39 Suttons Industrial Park
London Road
Reading RG9 6A2
Tel: 0734 664646

Dataview Wordcraft	**disc**	**£49.95**





script, or superscript, it is possible to specify the escape code and chr$ to 'ENABLE' that particular function by designating that code to the Commodore key + a number. This is the only word processor I have seen with this specification.

40 column solved

Viza Software have overcome the problem of a 40 column display very effectively. It is possible to either type as normal in which case the whole screen scrolls to the left as text is inserted (which I find off-putting) or press the Commodore key and W (for width); the text is then re-formatted to 40 column. Thus, you can see everything you type at all times without the off-putting scroll. If you press the Commodore key and W again, the text is instantly returned to the original width. A post-formatted word processor is alright when churning out blocks of text but I find them hard to use when presentation is important. No doubt, many people will disagree!

Spellbound

Vizaspell is a spelling checker which is loaded from within Vizawrite. Once the spell check is over, the program returns to Vizawrite with two keypresses. There is a built-in dictionary which contains 30000 words and can learn many more. If you have specialist needs, the dictionary can be edited.

Legally binding

Vizawrite is probably the most expensive of the most popular word processors, but you get what you pay for.

It is equally capable of both home and business use and I know of at least two solicitors offices where it is their only word processor. With their specialised jargon, the spelling checker is ideal and the time it saves has paid for Vizawrite many times over.

I feel that, if you are going to buy a word processor for the first time, or wish to change your present system, you can't fail with Vizawrite. It's part of my electronic office.

Black marks

One oddity present on Vizawrite is the way in which it uses a micro full stop instead of a space. This is an odd quirk which appears to have no particular function. The micro full stop is too small to get confused with an ordinary full stop but I am at a loss as to why it is there.

My other moan is the start-up colours on the screen. The first thing I do when starting a document is to change the colour combinations to black screen and border with green text.



Silicon spreadsheets

Electronic spreadhseets are possibly one of the most under-appreciated pieces of business software on home computers. In many cases, the spreadsheet is used as a glorified desktop calculator. But, with time and practice, a spreadsheet can be a most valuable tool where any type of numeric manipulation and forecasting is required.

Going by the book

A very handy book is   . It will not only work out formulae for solving specific problems but also has models for cash flow projection, job costing, work analysis and so on which can be converted to work on most good spreadsheets.

Cartridge disc and turbo

Vizastar is available in 2 different versions – both are on cartridge (4K or 8K) which also require a disc.

The screen display reminds me of the Macintosh screen. It is totally professional with smooth and simple movement around the screen.

Busicalc is more conventional. One plus is its very impressive turbo load system.

Spoilt for choice

In my electronic office, I find it hard to choose between Vizastar and Busicalc.

Busicalc is purely a spreadsheet whereas Vizastar is also a programmable database. But, both are excellent pieces of software which illustrate just how good a tool the Commodore 64 can be in a business environment. Both work fast – global calculation is noticably faster than on most of the other spreadsheets listed below.

On the minus side, the manuals are helpful but do not stimulate the imagination. Vizastar also contains an excellent demo program which points out some possibilities but still leaves the user a little dry.

Setting a standard

Spreadsheets are one of the few programs where a degree of standardisation is present. From my experience, if you press a particular letter, you tend to get the same menu of choices. This does mean that if you are in a situation where you are using a spreadsheet in a business environment on your micro, it would be possible for you to have a similar arrangement on your 64 at home. For development and experimental purposes, this is a tremendous help. I am aware of one instance where a complete cashflow forecasting model was set up on a 64 and then transferred to a spreadsheet on a Sirius. All the development was done by one man at home.

It is hard to do a spreadsheet justice in a demonstration in a retail outlet. A good demonstration takes time, and in an average chain store, the retailer probably won't know much more than you. Try and find somebody who already owns one, and ask them to let you experiment.

Other offerings

Neither Busicalc or Vizastar are cheap but both are well worth the money.

The spreadsheets mentioned below are other goodies. But, beware, there are some spreadsheets lurking around that are so bad that they are hardly worth the disc they are stored on. So, look before you leap!

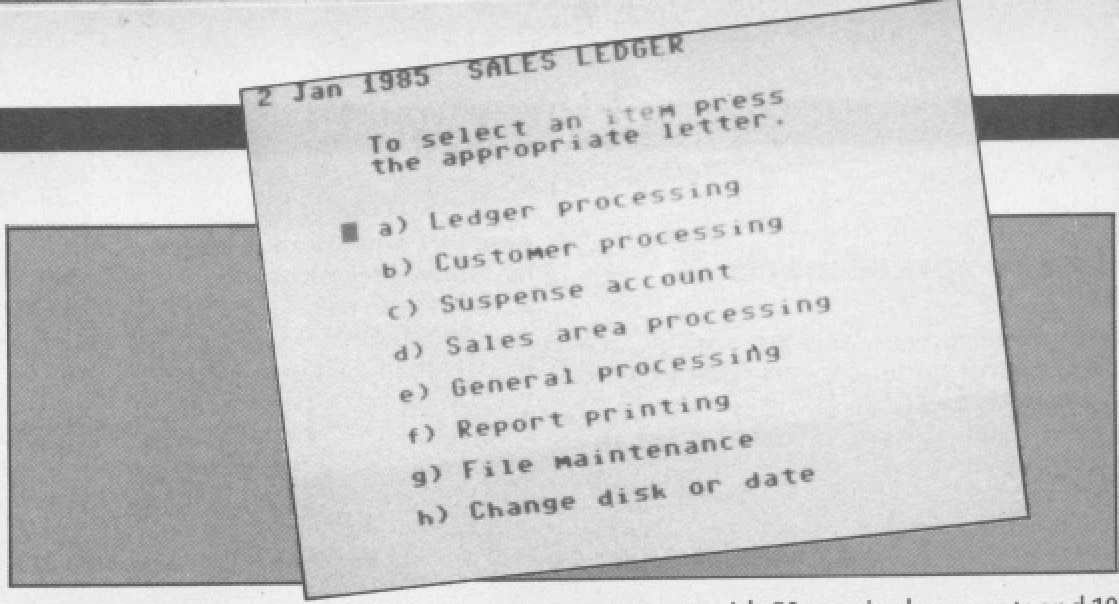


Viza software
(see above for address)
Vizastar — **disc/cartridge** — **£99.95 inc VAT**

Supersoft
Winchester House
Canning Road
Weladstone
Harrow
Middlesex HA3 7SJ
Tel: 01-861 1166
Busicalc — **disc** — **£75.00**

Audiogenic
(see above for address)
Micro Swift — **disc** — **£19.95**

Practicorp
Goddard Road
Whitehouse Industrial Estate
Ipswich
Suffolk
IP1 5NP
Tel: 0473 462721
Practicalc II — **disc** — **£69.95**



Money-go-round

Sales ledgers, purchase ledgers, cash books and nominal ledgers deserve a business supplement to themselves. There are several available and the intricacies are such that it is difficult to recommend one in particular.

Incapacitated

Most businesses have the same basic needs as far as ledgers are concerned although the methods used may differ greatly.

One problem many people have when they have been running programs like these for a while is the sudden realisation that they do not have sufficient account capacity. Before buying, make sure that you know how many accounts you have, approximately how many invoices the largest account may have and so on. Ensure that the person selling you the package understands your requirements.

Field testing

A problem with reviewing this type of package is field testing. It is possible to enter sets of dummy data and feel that everything looks OK but, when a program is being used fully and regularly, things can be quite different. I must, therefore, point out that my observations are based either on dummy data or a few weeks side by side true use.

My star buy based on these points is the set of software from Anagram.

Essentially, this is a cashbook, sales ledger and purchase ledger. There are other modules such as stock control but these are not relevant in this context.

Anagram's software has been available for a wide range of Commodores for a long time so the format they have found has been well tried and tested. They are as easy to use as ledger can be and are professional packages.

The question of integration

There is no integration but then total integration of modules would be expecting too much of the 64. However, the structuring of the programs is so good that little 'end work' is required.

The manuals are clear and concise but, if you don't know how to run a ledger, it may be worthwhile investing in a book such as Bookkeeping Made Simple.

The sales ledger has help screens in order to prompt you; these can be found for most parts of the program where you may encounter problems. Invoice printing is part of the sales ledger and posting to the relevant account is done via a separate option. Cash sales are entered into a separate cash account.

The capacity of the software depends on the amount of information that is to be stored on each account. But, Anagram say that it will handle 220 accounts where there is a maximum of 13 invoices per account or 110 accounts where there is a maximum of 25 invoices per account.

Anagram's sales ledger is very comprehensive and would not be out of place in any small business.

Purchase ledger

This includes nominal analysis and is in the same format as the sales ledger, so ease of use is guaranteed. Capacities again depend on how many transactions per customer are needed but, as a guide, Anagram say 150 supplier acounts and 50 nominal accounts with 4 outstanding invoices per account or 75 supplier accounts with 50 nominal accounts and 10 outstanding invoices per account.

Cashing in

The cash book is the easiest to get to grips with and may be quite enough for business where most trade is done in cash and cannot justify running a sales and purchase ledger. Its capacity is 50 analysis headings with approximately 2500 postings of 100 analysis headings with 2000 postings. Once again, reports are complete and very well laid out.

Extra, extra

Company Pack 123 from Impex is very good. Bookkeeping for the cash trader from Quick-Count is also very good as are the others mentioned below. I have intentionally omitted any packages that I found unreliable or too hard to use.

Anagram Systems
60a Queen Street
Horsham
West Sussex
RH13 5AD
Tel: (0403) 59551

Purchase ledger £75.00 inc VAT
Sales ledger £75.00 inc VAT
Cash Book £75.00 inc VAT

Impex Software
Metro House
Second Way
Wembley
Middlesex
HA9 0TY
Tel: 01-900 0999

Company Pack 123 £113.79 inc VAT
(Sales ledger, Purchase ledger, Invoicing, Stock control and Nominal ledger)

Quick Count
15 Neeld Crescent
London
NW4 3RP

Bookkeeping for Cash Trader £89.70

Abacus Business Systems
21 Union Street
Ramsbottom
Lancashire
Tel: 070682 7775

Purchase/sales ledger £37.95

The printed word

Choosing a printer for your Commodore computer can be difficult. Due to the printer port, some type of interface will be needed in order to connect a non-Commodore printer.

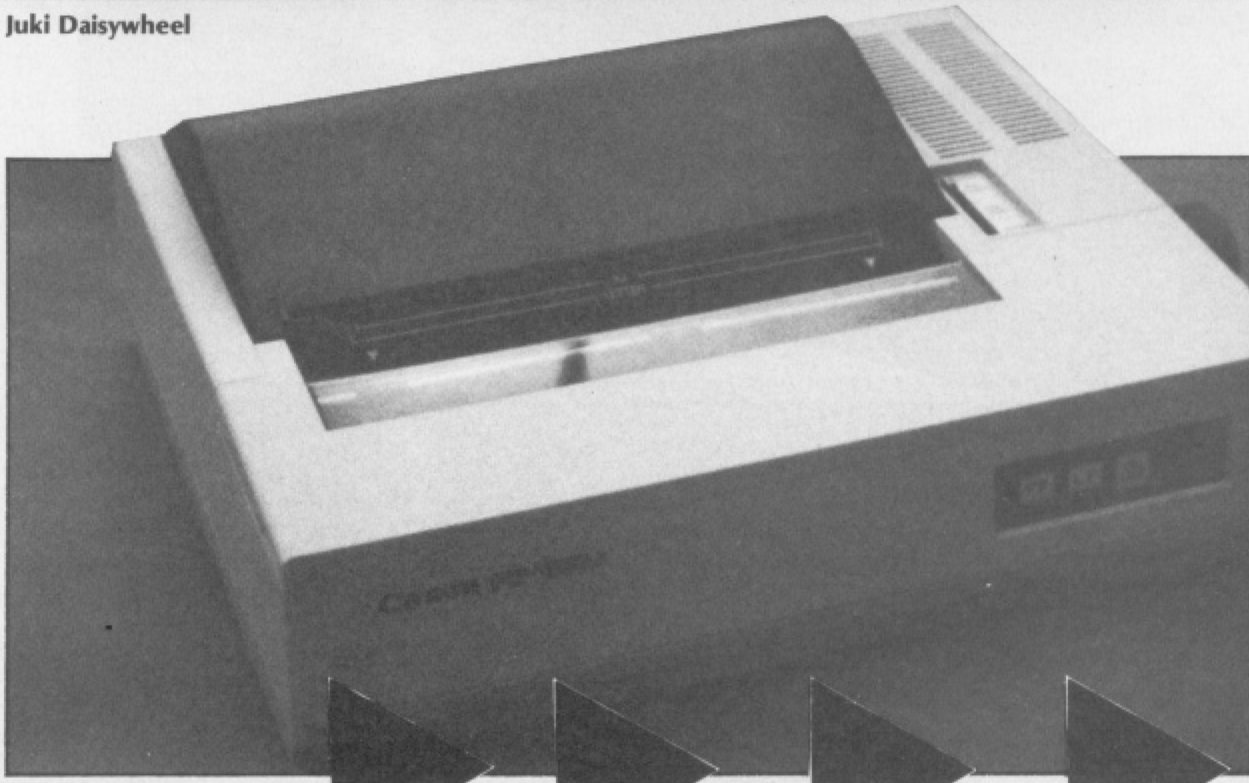
The Commodore MPS801 is the budget printer in the Commodore range but its facilities are rather limited, and the other printers in the range are not particularly easy to obtain.

The answer is to buy another make and the relevant interface. The most popular non-Commodore dot-matrix printer appears to be an Epson compatible Centronics type. These usually offer many facilities not available on the MPS801. Those choosing daisywheel printers are also going for the centronics type.

There are a wide range of interfaces to drive a printer. These can either be software based or, what I call, *hard units*. The software based interfaces consist of a lead and driver software. The disadvantage with this arrangement is that you may find that the driver software conflicts in memory with the program with which you wish to use the printer. There are no such problems with hard units. My particular favourite is the Turboprint GT which was reviewed in the December issue of Your Commodore.



Juki Daisywheel


Canon PW-108A

Canon PW-108A

This is a near letter qualtiy dot matrix printer. It is a little on the large side, weighing a hefty 8kg. Its speed is a nifty 160cps in ordinary mode and 27cps in near letter quality mode. I have seen better NLQ printers but overall the print quality is very good, and for me a lot better than the Epson. It supports enlarged type, condensed, elite, proportional, 8/9 dot graphics and, with a good interface, these options are easy to select. Paper loading is easy except that, if you have pin-feed paper and the lever is set at friction, the paper fouls up. There is a 2K printer buffer which is useful on small print-runs since it is sufficient to release the computer fairly quickly.

Overall I found this fast, very quiet, and reliable and I would imagine it would be long lasting even with high usage.

MP-165

The Micro Peripherals MP-165 was another NLQ printer. Its specifications were fairly close to the Canon even down to Sinclair ZX 80/81 type switches. This would probably be a wiser buy than a Canon. Not only is it cheaper but it also uses Epson FX ribbons which are usually available at even the most humble stationery shop – unlike Canon ribbons which I had great problems in obtaining. It is not as quiet as the Canon but the level was acceptable. It's NLQ mode (called fine on this) was very good, with the bonus that it could be turned on part way through text print. With a little practice I found I could highlight paragraphs by pressing the 'fine' switch at the start of the paragraph and pressing it again at the end.

Like the Canon, this appeared to be a workhorse.

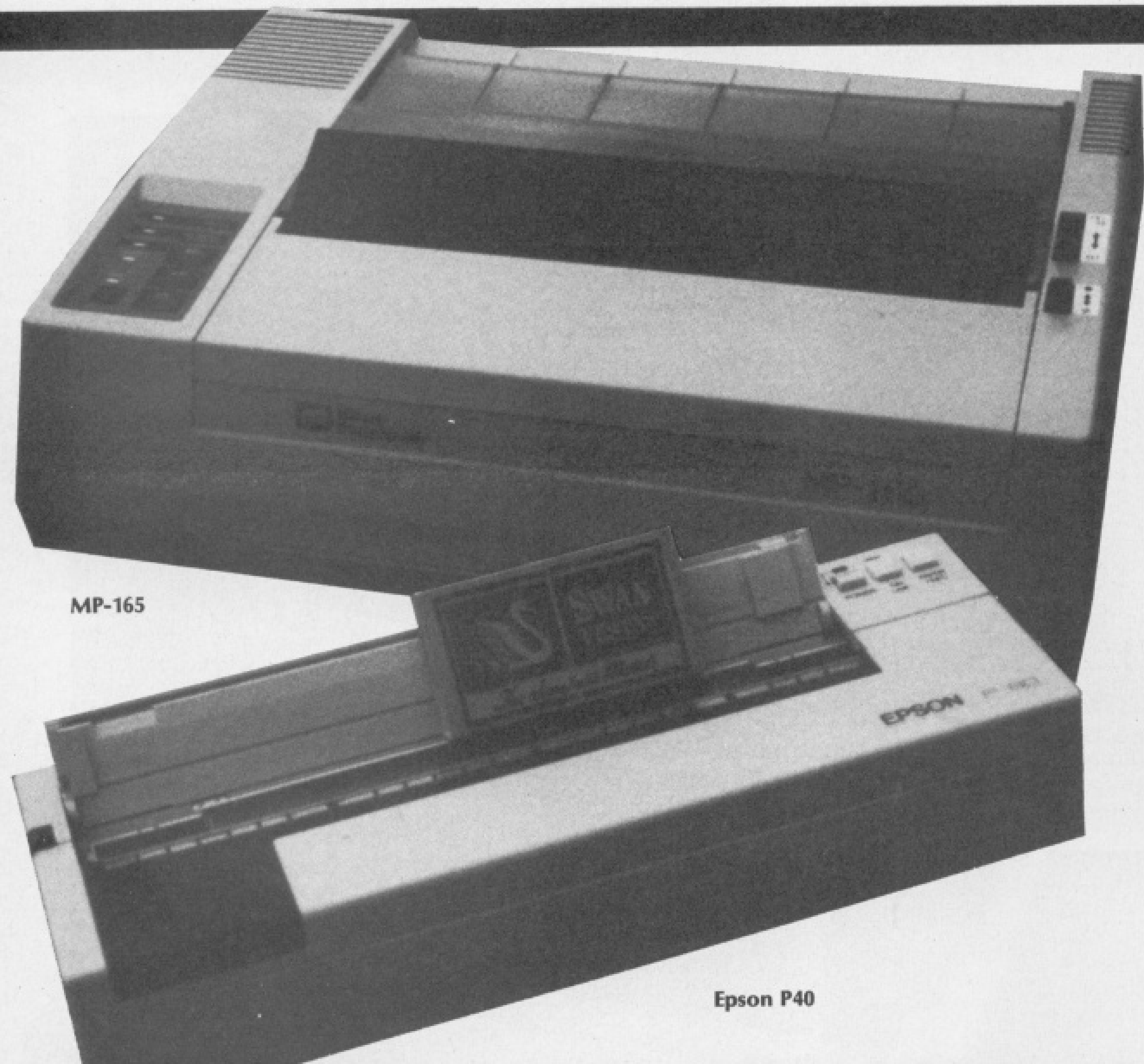
The JUKI Daisywheel

This typewriter/printer is for those of you who are prepared to sacrifice speed for high quality printout. The Juki is so slow in fact that I found I could type faster than it could print (...unusual but a great ego booster).

The Juki does have the advantage of being a typewriter as well but I would imagine this would be the choice of the irregular, low volume user.

It has some nice touches such as delete mode: you can go back over a mistake, 'lift' the old character, and overtype with the correct character. It also supported decimal tabs and centering of text. But the quality left a little to be desired and it did look like a budget machine.

The ribbon only lasted a few



MP-165

Epson P40

Norbain Micros Ltd. Norbain House Boulton Road Reading Berks RG2 0LT **Turboprint/GT**	Tel: 0734 752201	**£65**
Canon UK Ltd Canon House 2 Manor Road Wallington Surrey SM6 0BW **Canon PW-108a**	Tel: 01-773 3173	**£349**
Micro Peripherals Ltd. Intec Unit 3 Hassocks Wood Wade Road Basingstoke Hants RG24 ONE **MP-165**	Tel: 0256 473232	**£289**
Juki (Europe) GMBH c/o Akhter Instruments Ltd. 28 Burnt Mill Harlow Essex CM20 2HU **Juki 2200**	Tel: 0279 443521	**£269**
Epson (UK) Dorland House 388 High Road Wembley Middlesex HA9 6UH **Epson P-40**	01-902 8892	**£160**

days and my attempts to obtain a new ribbon proved futile and so it sits here unused and unloved.

The Epson

This is rather different to the other three printers mentioned here. It is a dot matrix printer with what I would call fairly standard Epson specifications, i.e., enlarged, condensed, emphasized, double strike, underline, italics and graphic modes. However, here is the difference:

297 mm(w) ★ 62 mm (h) ★ 107 mm (l).

For those of you (like me) that were born before 1960 that could be about as big as a London bus. In fact it is about 11 inches wide ★ 3 inches deep and 2.5 inches high.

Small, yes, but packed full of fun. It will print on ordinary paper or heat sensitive paper. It is friction fed and, if you have a portable, it is mains or ni/cad battery powered.

A full 80 column print-out might make you think that the end result was printed out on one of its bigger brothers, and for only £160 (appx) it's on the cheap side too. It is not particularly fast 40cps (max) but for the convenience of a mini printer, its speed is worth tolerating.

The print quality is very good. There is a variable density setting so you should get a reasonable printout on most paper although smooth is recommended. The type face is very obviously Epson but that is not a bad thing.

For anybody who finds space a problem this may well be the answer. Now all I need is to get my SX-64 running on an Ever Ready PP9!

Summing up

This has been a very brief look at just four of the wide range of printers that can be hooked up to the 64. Before you buy a printer, check the ribbon situation. If the lid breaks the printer will still work, if the case splits, the printer will still work, but if you cannot get a spare ribbon you are stuck!

Bits and pieces

Romag Ceaf Screen Filter

When you are in front of a screen for any length of time, even the smallest refelction can be a source of great irritation. The Romag Ceaf screen helps ease the problem. At its price it is remarkable value. It is glass as opposed to plastic and does get rid of all but the most direct reflections.

Velcro strips are used to fix the screen to your monitor/TV which is a little crude and untidy but once there it is fairly safe. There is little loss of picture quality with the screen in place and the whole effect is more restful to the eye. Because of the high density of the screen you will need to increase the brightness quite a lot. There are other screens available but most appear to be close to £100. This is a crude but effective solution at a fraction of the cost. A good gift for the compulsive operator.

Romag Ceaf
Tel: 091-414 5524
Screen filter **£19.95**

Zero Electronics
149 Kingstreet (Nash House)
Great Yarmouth
NR30 2PA
Tel: 0493 842023
80m Column Card **£73.85**

Impex Software Ltd.
Metro House
Second Way
Wembley
Middlesex HA9 0TY
Tel: 01-900 0999
Textview 80 column cartridge **£59.95**

Zero 80 Column Card

This is a sophisticated piece of kit which isn't cheap. But for the money, they could have provided a decent manual rather than the Double Dutch translation which passes for a manual.

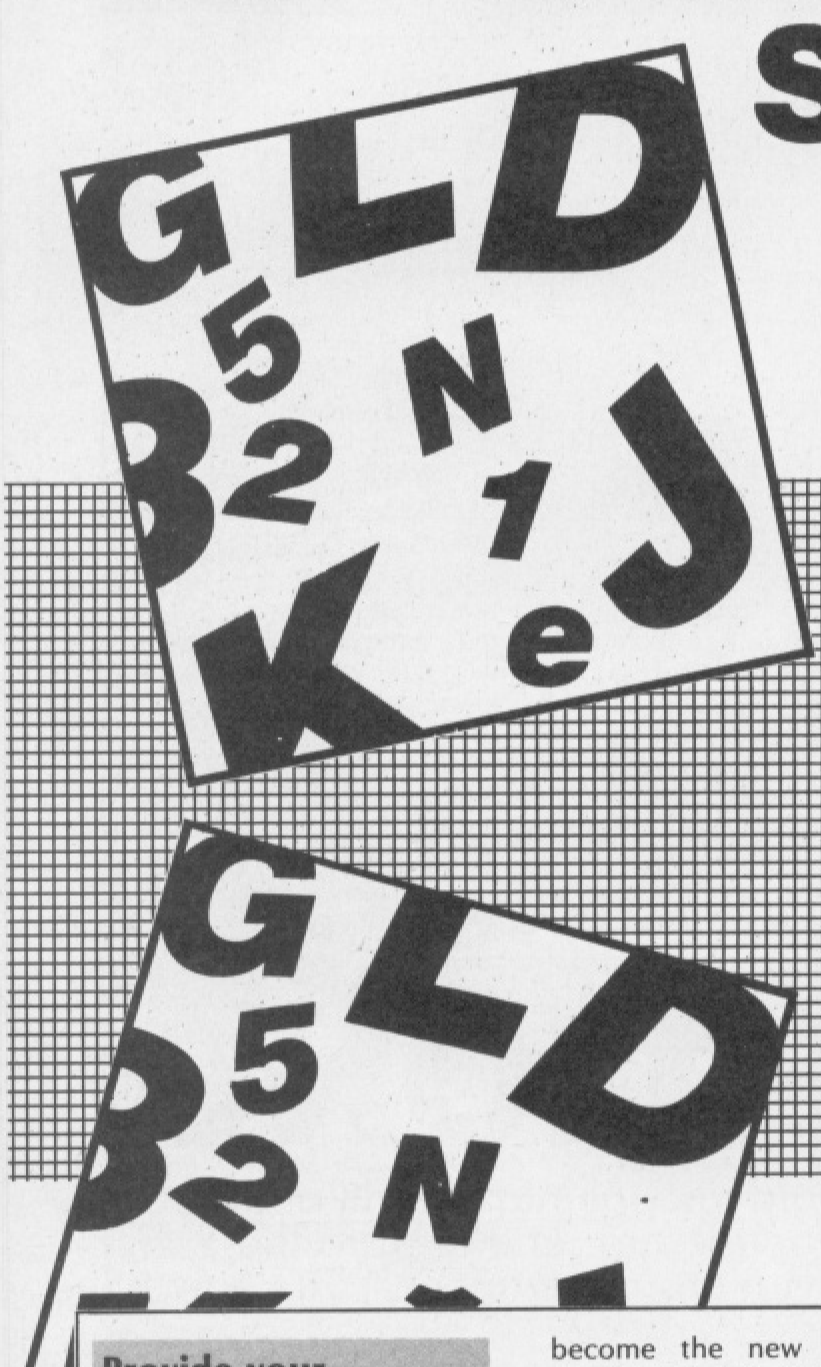
The display was very impressive – clear text, easily read and a digital clock in the corner. Ah! yes. The clock. It is about as accurate as Herr Davies potting a black. The time on the clock appears to be Dutch summer time!

The word processor provided is not too bad if you like the post-formatted type and it does have a preview facility.

On the whole it is a nice tool. It does not function with much commercial software but, if you write a lot of your own programs and feel they would look better in 80 column mode, then this would be a useful thing to get.

It certainly beats the Impex Textview. I tried this on three monitors and the text was barely readable. I was surprised since Impex releases are usually good.

64 CHARACTER SET





Provide your Commodore 64 with an extra character set with this utility from J.A. Wolfe

THE FEATURES OF THIS utility are as follows:

1) Whilst providing the alternative characters, the original built in 'alpha' characters are still accessible although the left-hand graphics are lost and the numeric keys are converted to the new graphic set.
2) The left-hand graphics now become the new 'alpha' character set and are accessed by using the shift key with the usual character key. This means that long strings or print statements may be easily entered by using the 'shift lock' key.
3) Pressing 'run stop' and 'restore' will reset the standard character set.
4) Many other user defined graphic routines consume a lot of memory, but this program only uses 1703 bytes leaving an ample 37208 bytes free in which to store your program.
5) The new characters are held in locations 12672 to 12759 and 12808 to 13025.
6) You may have the two character sets displayed on the screen simultaneously.

```
READY.

10000 REM ******************************
10010 REM **CHAR' SET (C)1985 J.WOLFE *
10020 REM ******************************
10030 PRINTCHR$(142)
10040 POKE52,48:POKE6,48
10050 POKE56334,PEEK(56334)AND254
10060 POKE1,PEEK(1)AND251
10070 FORI=0TO511:POKEI+12288,PEEK(I+53248):NEXT
10080 POKE1,PEEK(1)OR4
10090 POKE56334,PEEK(56334)OR1
10400 POKE53272,(PEEK(53272)AND240)+12
10410 FORT=12808TO13015:READDAT:POKET,DAT:NEXT
10420 FORT=12672TO12759:READDAT:POKET,DAT:NEXT
10130 REM ********************
10140 REM *** ALPHA UDG'S ***
10150 REM ********************
10160 DATA62,127,99,99,127,231,231,0
10170 DATA127,99,99,110,110,99,127,0
10180 DATA63,115,115,96,96,99,63,0
10190 DATA126,127,99,99,115,115,126,0
10200 DATA127,103,96,112,126,96,127,0
10210 DATA127,111,96,124,124,96,112,0
10220 DATA63,99,96,111,103,99,127,0
10230 DATA115,115,99,127,127,99,103,0
10240 DATA127,24,24,24,28,28,127,0
10250 DATA127,111,12,12,12,14,127,0
10260 DATA102,110,120,120,120,127,103,0
10270 DATA112,112,112,112,96,99,127,0
10280 DATA119,127,107,99,99,103,103,0
10290 DATA103,115,123,111,103,99,103,0
10300 DATA62,103,103,99,99,115,62,0
10310 DATA127,127,99,99,111,96,112,0
10320 DATA62,126,110,110,102,103,127,0
10330 DATA127,99,103,127,124,102,115,0
10340 DATA127,99,96,127,3,99,127,0
10350 DATA127,91,24,24,24,56,56,0
10360 DATA102,102,102,102,103,103,63,0
10370 DATA99,99,99,99,103,103,28,0
10380 DATA115,115,99,99,107,127,54,0
10390 DATA99,99,54,60,60,54,99,0
10400 DATA99,99,54,24,24,28,28,0
10410 DATA127,127,102,12,24,115,127,0
10420 REM **********************
10430 REM *** NUMERIC UDG'S ***
10440 REM **********************
10450 DATA62,103,111,123,115,99,62,0
10460 DATA28,28,60,12,12,14,63,0
10470 DATA127,3,3,127,96,103,127,0
10480 DATA127,99,7,127,7,99,127,0
10490 DATA112,112,112,102,102,127,6,0
10500 DATA127,119,112,127,3,99,127,0
10510 DATA127,103,96,127,115,115,127,0
10520 DATA127,99,7,31,12,12,12,0
10530 DATA127,115,99,127,99,103,127,0
10540 DATA127,99,99,127,3,115,127,0
10550 DATA255,255,255,255,255,255,255,255

READY.
```

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EASYSCRIPT	(DISK)	~~£75.00~~	£65.00	PRACTICALC	(TAPE)	~~£39.95~~	£34.95
EASYSPELL	(DISK)	~~£50.00~~	£41.95	HOMEBASE 1-4	(SUPERBASE)		£17.95
SIMON'S BASIC	(CART)	~~£50.00~~	£41.95	STEPPING STONES	(SUPERBASE)		£9.95
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ORDER AS DCL4

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Once you've got to grips with your Character Designer, use it to design a screen. Send your work of art to Virgin Games before the closing date of July 31st, 1985. The winner will be the reader who, in the eyes of our panel of judges has produced the most professional and artistic screen with the assistance of their Character Designer. The panel of judges consists of Jeremy Cooke of Virgin Games and the editors of Your Commodore and Home Computing Weekly.

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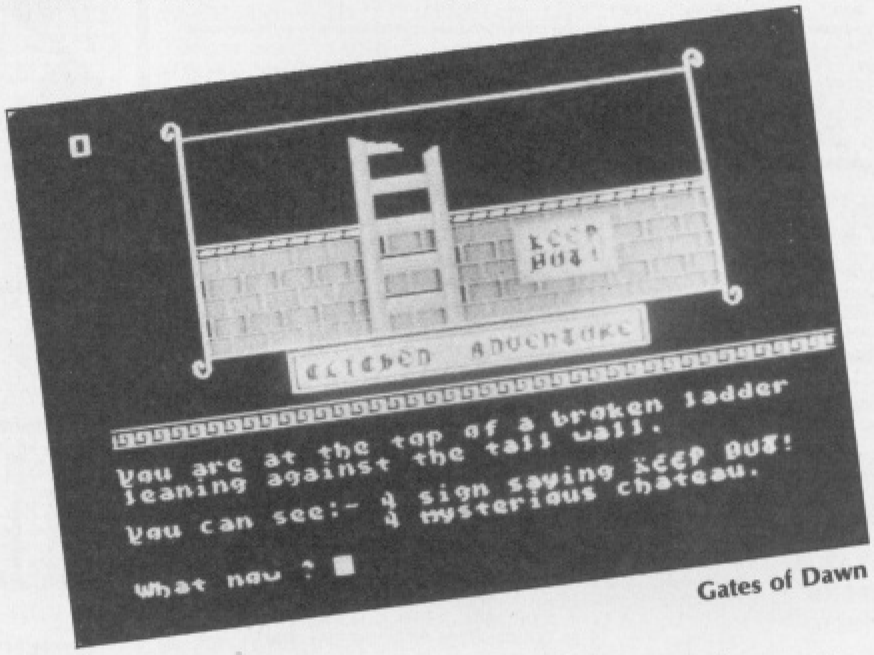
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THIS EXTREMELY POWERFUL PIECE OF professional software allows you to edit up to four individual character sets containing 256 characters each – a total of 1024 characters – in memory simultaneously. The use of raster interrupt techniques enables the entire character set to be redefined without affecting the main screen display.

With most character designers if you redefine your alphabet to look like, say, Space Invaders the on-screen prompts will turn to Space Invaders too! Not so with Character Designer!



Gates of Dawn

Although designed for the professional user Character Designer is extremely user-friendly and suitable for anyone who is willing to spend a little time reading this documentation to familiarise themselves with the scope of commands. All commands are entered with a single keypress, or via the joystick, and a help screen is available displaying the options.

The program is written in 100% machine code and occupies only 5K of memory including the HELP screen. It also includes a screen designer enabling you to see the characters in combination on-screen or to design a screen for use in a BASIC or machine code program.

Loading

To load type: LOAD"( )",1,1 (press ENTER)
To run type: SYS 16384 (press ENTER)

This program requires a joystick plugged into port 2.

If the computer has just been switched on or you haven't loaded a character set, the bottom of the screen will contain garbage, both in the character set itself and in the space above. The six lines above the set are all spaces (character 32). You can rid yourself of this unsightly mess by redefining character 32 to be totally devoid of "set" pixels and thus a genuine empty space. Alternatively you could copy one of the Commodore sets, or load a previously saved set.

If at any time you return to BASIC by hitting RUN/STOP and RESTORE, the program can be restarted without loss of data using SYS 16384.

If you wish to have a small BASIC program in memory at the same time as Character Designer, after loading Character Designer type:
POKE 52,15:POKE 56,15:NEW
to lower the top of memory to 3840 then load your program and enter SYS 16384

Character sets

On the Commodore 64 all graphics are handled by the dedicated VIC II chip. One drawback of this chip is that it can only look at 16K of memory at a time. This 16K needs to contain all of the data for the

character set(s), sprites and screen data (See Memory Map).

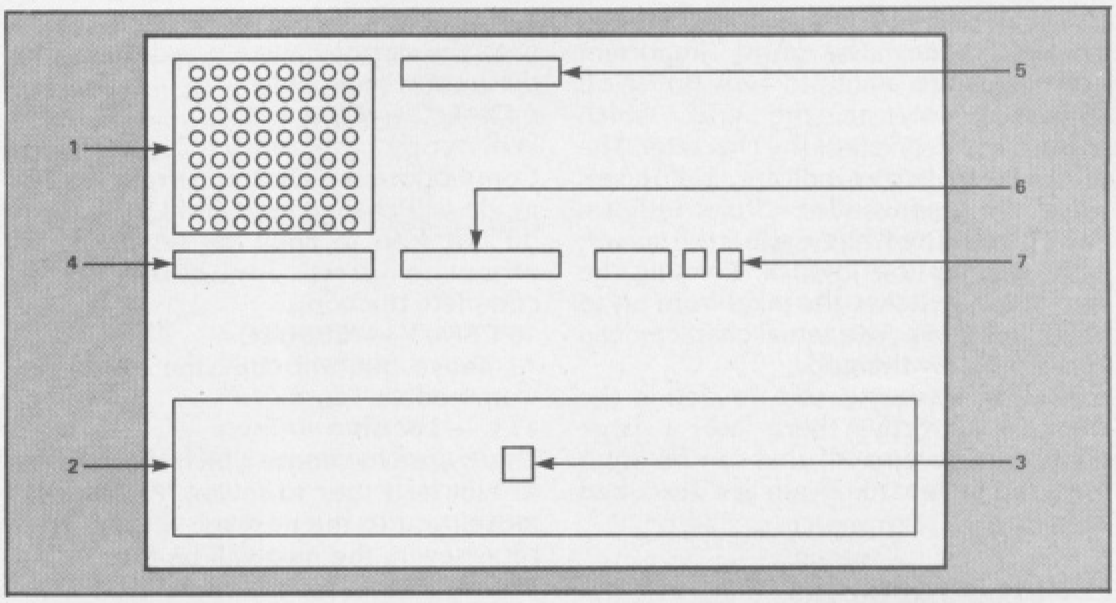
If a screen is drawn in hi-res mode, 9K of memory is used in total out of the 16K available, which is why most commercial programs tend to use a character mode, but instead of being letters these are redefined to make up a small part of the picture and are then placed together on the screen.

To define such characters without the aid of a utility such as Character Designer involves sketching your design on graph paper, testing your binary arithmetic converting the sketches to date, typing in endless lists of data statements and then finally running a BASIC program to POKE the characters into memory.

Character Designer allows you to the TV screen or monitor instead of graph paper, then it does all of the calculations and POKEing to memory. The data is saved to tape or disc as a block of memory which can be loaded from within a BASIC program or as part of a machine code program eliminating the time-consuming use of DATA statements.

Character Designer enables you to work on 1024 characters in memory at the same time. These are divided into four sets of 256 characters, each occupying 2K of memory. Your program can use any of these sets instead of the Commodore sets and even switch between sets during a program with a simple POKE (see Switching Character Sets).

You could redefine the alphabet to give you, say, gothic script or italics or even a futuristic character set for use in your latest space epic. Or maybe by defining blocks of characters as walls, trees etc, you can create amazing backgrounds over which sprites can do battle, or whatever it is sprites care to do! At the risk of sounding clichéd, the only limit is your imagination!



Colour table

One method often used in commercial software to save time and memory and help simplify programming in multi-screen games is to allocate a colour to each character. This method is used by Character Designer.

The character designer section allows you to set the colour of each character. This colour is stored in a 256-byte table (one byte for each character in the set) and is primarily used by the screen designer when printing a character.

As with the character set the colour table can be saved to tape or disc and loaded again for use in your own program.

Memory map

The diagram below shows how Character Designer is located in RAM along with the character sets, colour table etc. (See also Programmer's Reference Guide, pp 104-105).

How Character Designer is located in RAM		**Hex**	**Decimal**
(1K bytes)	Designed Screen	$6400	25600
		$6000	24576
(256 bytes)	Colour table	$5500	21760
		$5400	21504
	Help screen	$5000	20480
Program loads here (15K)	Program	$4000	16384
Redefinable character sets (2K each)	Set 7	$3800	14336
	Set 6	$3000	12288
	Set 5	$2800	10240
	Set 4	$2000	8192
Commodore character generator ROM image not definable	Set 3 CBM L/C U/C	$1800	6144
(4K bytes)	Set 2 CBM L/C graphics	$1000	4096
(64K bytes)	Cursor-sprite	$0FC0	4032

Using the Character Designer

Screen layout

1 Grid on which an 8 × 8 pixel character can be edited.
2 Character set: the current set of 256 characters.
3 Cursor indicating character being edited.
4 Character being edited, displayed along with its "POKE code".
5 Mode indicates current process. Should read EDIT or SELECT.
6 Current set, numbered from 4 to 7.
7 Multi-colour indicator – reads ON or OFF. The coloured figures show the selected multi-colours.

As mentioned in the section on loading Character Designer is run by typing SYS16384. If the computer has just been switched on or you haven't loaded a character set the bottom of the screen will contain garbage, both in the character set itself and in the space above. The six lines above the set all contain 'spaces' (i.e. character 32). When you run Character Designer the screen will appear full of unsightly garbage. Clearing character 32 of any set pixels (making it a true empty space) will clear the top six lines and loading a Commodore character set or one of your own will make sense out of the bottom lines.

Select mode

This is the mode of the designer when first run, allowing you to move quickly to any character. Using the joystick in port 2 the character to be edited, indicated by the flashing cursor, can be selected from the current character set. The cursor can be moved in all four directions. When the fire button or any key is pressed the designer goes into EDIT mode.

Edit mode

Once your chosen character has been selected and button or key pressed you will be in EDIT mode. As suggested by the

name, all editing commands are entered in this mode. The most important function is the ability to turn on or off individual dots on the grid, which correspond to pixels of the character. The purple filled circles indicate "on" pixels whilst the green hollow circles indicate "off" pixels. The white circle is the cursor, controlled by the joystick. Pressing the fire button switches the pixel from off to on or vice versa. The actual character can be seen below the grid.

As well as being able to design the character directly, there are a large number of commands that can be input from the keyboard. These are described as follows.

Editing commands

The commands are all initiated with a single key press and are detailed in the order they appear on the HELP screen.

1 Left arrow and up arrow — mirror
These keys mirror the character on the grid horizontally and vertically respectively. NB. These are *not* the cursor keys but the keys to the left of the "I" key and to the right of the "*" key.

2 I-Invert
Inverts the character on the grid: i.e. all "on" pixel off or vice versa.

3 R —Rotate
Each press of "R" rotates the current character 90 degrees anticlockwise.

4 Cursor keys
These scroll the character on the grid one pixel in the appropriate direction with full wrap-round.

5 Shift /CLR
Clears the grid, making the current character a space.

6 Home
Returns the cursor to the top left of the grid.

7 C — Copy
This powerful command enables any character from any of the four sets to be copied to the current character. When "C" is pressed the mode changes to "COPY", the bottom cursor stops flashing, and the prompt "SET?" appears. If the "L" key is pressed the designer cycles through the four sets (as described under LOCATE). When the desired set is located, or if you wish to copy from the set on show, simply move the joystick or press the button. The prompt will change to "CHAR?" and the cursor will start flashing. The character to be copied can now be chosen with the joystick as described later in the section dealing with SELECT MODE, i.e. as soon as the button is pressed that character and its colour will be copied to the current character.

8 X — exchange
This enables the current character to be swapped with another character from the same set. On pressing "X" the mode changes to "XCHANGE". Simply select the character with which to swap the current character by moving the joystick until the cursor covers it and then press the button or any key.

9 CBM/C — CBM U/C
Will copy the entire upper case Commodore set into the current set. The mode will change to "CBM U/C". If you do not wish to copy the set press "N" otherwise press any other key to complete the copy.

10 CBM/V — CBM/LC
As above but will copy the lower case Commodore set.

11 L — Location
This is used to choose which character set to edit (sets four to seven). Pressing "L" moves you to the next set. If the current set is seven, the next will be four.

12 S — Select
This puts the designer into SELECT mode.

13 N — Next
Will advance to the next character. If the current character is 255, this will have no effect.

14 P — Previous
Will go back to the previous character. If the current character is 0 this will have no effect.

15 SHIFT/N — Number
This allows you to input a character as eight decimal numbers. When SHIFT/N is pressed the mode will change to "NUMBER" and a prompt ">" will appear by the top row of the grid. A decimal number (0-255) can be typed in followed by RETURN. If a number greater than 255 is entered it will disappear leaving just the prompt. If there is no number following the prompt when RETURN is pressed it will have no effect on the current row. This is then repeated for the remaining seven rows.

16 D — Data
This prints eight items of data in decimal alongside the character. This list will disappear when any key is pressed.

17 F1 — Character colour
Advances the colour of the current character.

18 F3 — Multi-colour 1
Advances multi-colour 1.

19 F5 — Multi-colour 2
Advances multi-colour 2.

20 F7 — Background
Advances background colour.

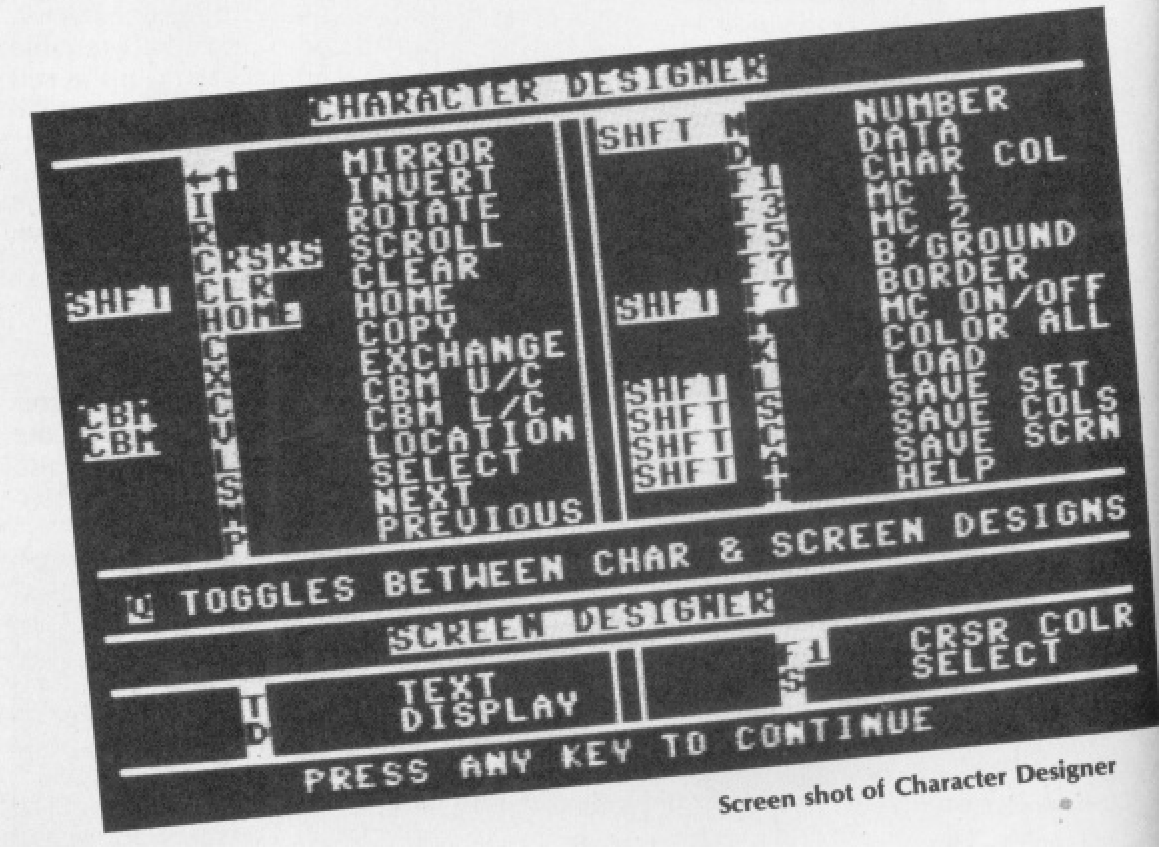
21 SHIFT/F7(F8) — Border
Advances border colour.

22 M — Multicolour ON/OFF
Turns multi-colour mode on or off.

23 K — Colour all
Will change *every* character colour to the colour of the current one.

24 Shift/L — Load
Loads a file. See Cassette and Disc Operation.

25 Shift/S — Save Set
Will save the current character set.



Screen shot of Character Designer

26 Shift/C — Save colour table
Will save colour table.

27 Shift/A — Save screen
Will save the designed screen.

28 H — Help
Will display the HELP screen.

29 Q — Quit
Will enter the Screen Designer.

NB Where the instructions say "press any key" (e.g. to leave SELECT mode) if the key pressed is a valid editing command it will then be executed.

Cassette and disc operation

These are the system messages as they appear on-screen:

SAVE COLOURS	Type of save or load
CASSETTE OR DISC	Type of device you are using
FILENAME BRICKS	The name you give your file

then:

PRESS RECORD AND PLAY ON TAPE

OK

SAVING BRICKS

PRESS ANY KEY

When any load or save command is entered the screen will clear and the following will appear:

a The type of operation (LOAD, SAVE CHARS, SAVE COLOURS or SAVE SCREEN)

b Select device – press C or D to select cassette or disc, followed by RETURN to confirm your choice. Character Designer will remember the previous device used, so normally you will just need to press RETURN.

c A filename of up to 16 characters can be entered from the keyboard followed by RETURN. Delete may be used as normal but the cursor keys and INSERT will not work. The only occasion on which a null file name can be used is during a cassette load.

When using a disc drive "@0:NAME" can be used for a save and replace and wildcards can be used for loading.

If using cassette the border will change to light blue and the prompt "PRESS PLAY ON TAPE" or "PRESS RECORD & PLAY ON TAPE" will appear. The screen will then blank and your Commodore 64 will load or save in the normal manner.

d After the load or save is completed, pressing any key will return you to the designer in SELECT mode.

Screen designer

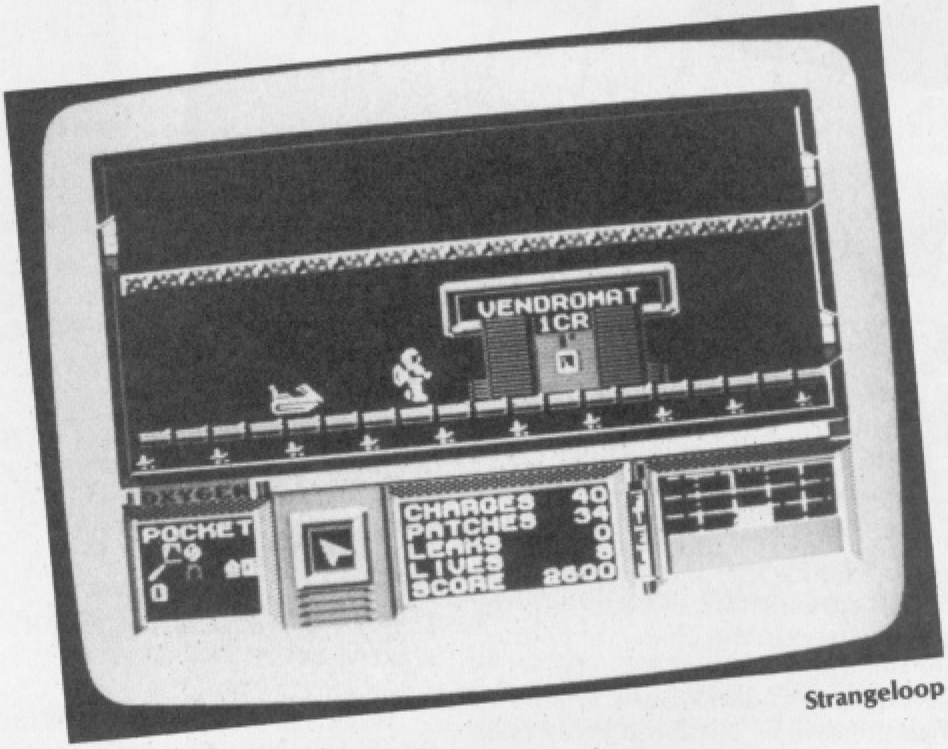
To enter the Screen Designer section of Character Designer press "Q" in EDIT or SELECT mode. If no screen has been designed or loaded you will see a screen full of garbage. Press SHIFT/CLR to clear the screen.

At the top left of the screen a white cursor will be visible; this can be moved around with the joystick. Pressing FIRE will put the current character at the cursor position. The character can be changed either by returning to the character designer and SELECTing a different character, or by pressing "S" or "G" (see below).

NB Only characters from the same set may be used on screen at any one time. The set used by the Screen Designer will be that currently chosen in character designer mode.

Summary of screen designer commands

SHIFT/CLR	Clear screen
HOME	Home cursor
SPACE	Put a space at cursor position
FIRE BUTTON	Put current character at cursor position with colour from colour table
G	get new character – if G is presesnt the character under the cursor becomes the current one
T	enter TEXT mode. The cursor will turn green and text can be entered from the keyboard. To exit TEXT mode press RETURN **NB:** Text mode assumes that the alphabet is in the normal Commodore upper case position, i.e. A=1, Z=26
Q	quit Screen Designer and return to Character Designer in SELECT mode



Strangeloop

D	Display current character at cursor position. When "D" is released the character will disappear
F1	change cursor colour from white to black or vice versa
S	select a new character; this will only work if the cursor is on the bottom eight lines. These bottom eight lines will be replaced by the current character set. The cursor may be moved around as usual and pressing FIRE will select the character under the cursor. No other commands will work while the character set is displayed. The set will turn off automatically when the cursor is moved out of the bottom eight lines and the bottom of your screen will reappear unharmed.

Hints and tips

This section is intended for the beginner but contains much information of use to the more advanced user.

Creating multi-colour graphics

In its normal hi-resolution colour mode the Commodore 64 can only display two colours in each character square: the background colour and the character colour. Luckily it is possible to display four colours in one square at the cost of halving the horizontal resolution. Although this give the graphics a slightly chunky look, much more colourful displays are possible.

Instead of a character being eight pixels wide, as in hi-res colour, a multi-colour character is only four pixels across, each pixel being twice the width of a hi-res pixel. this means that with Character Designer we are able to use two dots for each of the four horizontal pixels with the

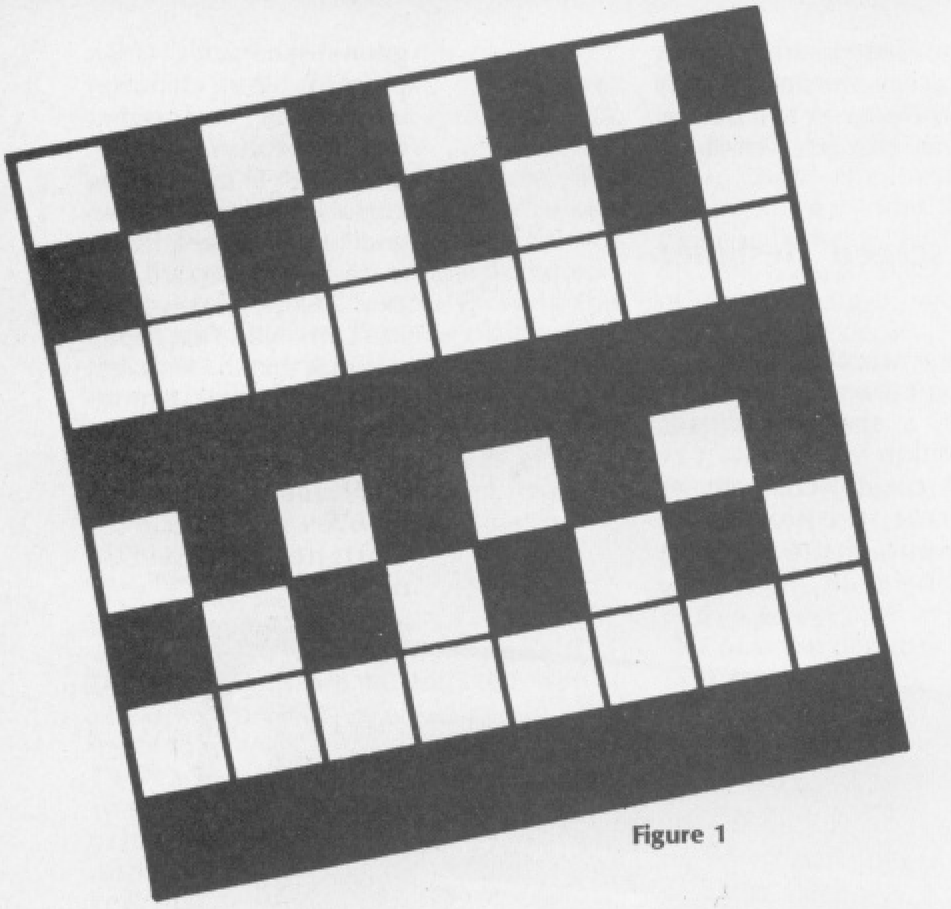


Figure 1

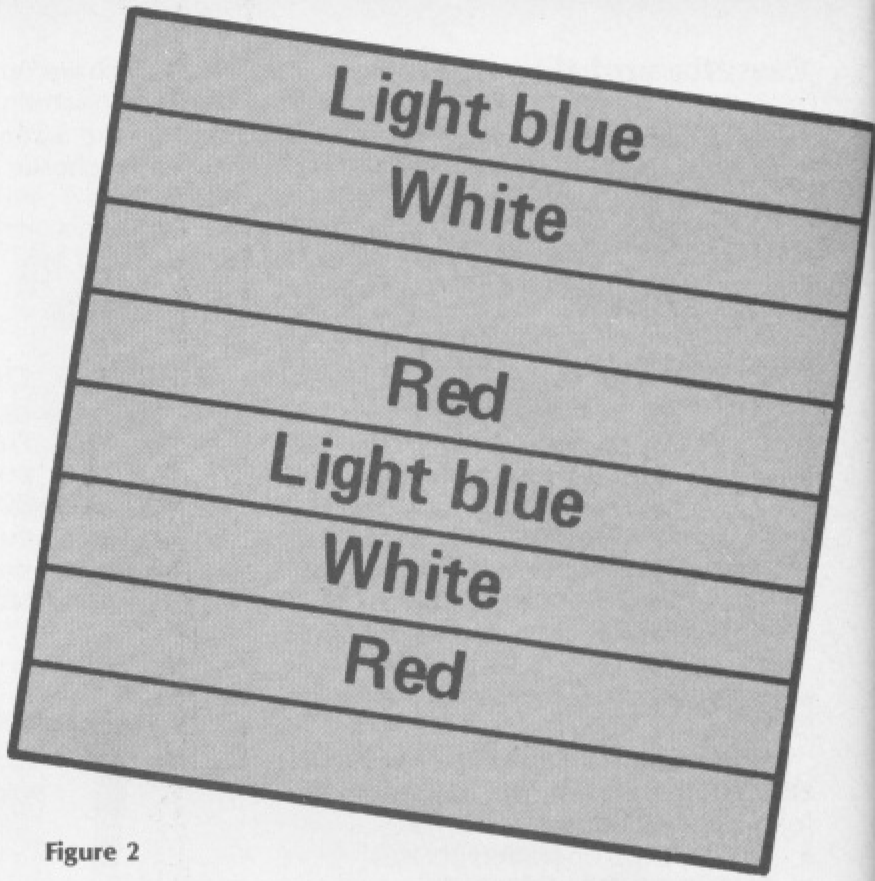


Figure 2

colour chosen according to the chart below:

OFF OFF	Background colour
OFF ON	Multi-colour one
ON OFF	Multi-colour two
ON ON	Character colour

You will notice that the chart says that when both dots are "on" the double pixel will be displayed in the character colour. This is not quite true. If the character colour is between 0 and 7 (black to yellow) the character will be displayed in hi-res. If the colour is between eight and 15 it will be displayed in multi-colour with the character colour appearing as character colour minus eight, e.g. if the character colour is 10 (light red) and multi-colour is on, any double pixels with both dots "on" will appear as colour 10 – 8 = 2 (red).

To demonstrate this try setting multi-colour one to light blue, multi-colour two to white and the character colour to red and switch multicolour ON. Then enter the following data into a spare character using NUMBER:
85, 170, 0, 255, 85, 170, 0, 255

You should see a red character like Figure 1. Now use F1 to advance the colour to yellow. Press F1 three more times and the characters should look like Figure 2.

You will notice that we are restricted to using the first eight colours (the ones printed on the keys) when using multi-colour, but if we wish to have the character actually appear in multi-colour we need to add eight to the desired colour code. No such restriction applies to the multicolours themselves where we can choose from all 16 colours. (See also Programmer's Reference Guide pp 115-119.)

Using graphics in your own programs

If you wish to use a character set you have designed in your own program you will need to use a program similar to the one that follows:

```
1  x = x + 1
2  IF x = 1 THEN LOAD "CHARS",1,1
3  REM YOUR PROGRAM
```

When run this program will firstly load the file called "CHARS", presuming of course that it is saved on tape after your program or you change tapes after your program has loaded. This will cause the 64 to continue running the program from the first time. (After a LOAD from within a program the 64 performs the equivalent of a GOTO (first line) retaining all variables.) After loading "CHARS" X will no longer be equal to one, so your program will run as normal. This will also work with several files as below:

```
1  X = X + 1
2  IF X = 1 THEN LOAD "CHARS",1,9
3  IF X = 2 THEN LOAD "COLOURS",1,1
4  IF X = 3 THEN LOAD "SCREEN",1,1
5  REM YOUR PROGRAM
```

You will need the programs saved to tape in the following order:
1 Your program **2** "Chars" **3** "Colours" **4** "Screen"

While developing a program you might like to have the files saved on separate tapes. In that case try putting some sort of prompt in line one:

```
1  X = X + 1: IF X<4 THEN PRINT
"CHANGE TAPE THEN PRESS ANYKEY":
WAIT 198,1:POKE 198,0
```

NB: WAIT 198,1 will stop the program until you press a key and the POKE will clear the keyboard buffer.)

Switching character sets

To choose which character set to use POKE 53272,X where X is one of the following values.

X	Set	Comments
20	2	Commodoree Upper case (default)
22	3	Commodore Lower case
24	4	
26	5	
28	6	
30	7	

Note that if you move the screen from its normal position (1024 - 2023) the value of X will need to be changed accordingly. See also Programmer's Reference Guide pp. 103-104.

Turning multi-colour on and off

To turn multi-colour mode on POKE 53270, PEEK (53270) OR 16.
To turn multi-colour mode off POKE 53270, PEEK (53270) AND 239

POKEing the screen

Printing to the screen using strings of cursor characters is a rather tedious method and also suffers from a certain sluggishness. It is often better to POKE directly to the screen memory.

If we first assign the following variables:

X = column number (0 - 39)
zy = row number (0 - 24)
SCREEN = 1024 (this is the usual position but it can be altered)
COLOUR = 55296 (the start of colour memory)

the addresses to be POKEd can be simply worked out with the following formulae:

```
PS = 40 * Y + X
POKE SCREEN + PS, (character number)
POKE COLOUR + PS, (colour code)
```

e.g.

```
100X = 20:Y = 15
110 PS = 40 * Y + X
120 POKE SCREEN + PS,1
130 POKE COLOUR + PS,1
```

will print a white "A" near the centre of the screen (providing that SCREEN and COLOUR have already been defined).

Using the colour table

If in addition to defining SCREEN and COLOUR we define another variable

CTAB = 21504

and use CHAR to hold the character number, the following subroutine will print a character using the colour table created with Character Designer.

```
100 PS = 40 * Y + X
110 POKE SCREEN + PS, CHAR
120 POKE COLOUR + PS, PEEK (CTAB +
CHAR)
130 RETURN
```

Background and border colours

To get the colours of the background, border and the multi-colours:

Border	– POKE 53280,X
Background– POKE	– POKE 53281,X
Multi-colour 1	– POKE 53282,X
Multi-colour 2	– POKE 53283,X

where X represents one of the following colours:

0	Black	8	Orange
1	White	9	Brown
2	Red	10	Light red
3	Cyan	11	Dark grey
4	Purple	12	Medium grey
5	Green	13	Light green
6	Blue	14	Light blue
7	Yellow	15	Light grey

Downloading a screen

You may wish to use a screen you have designed using Character Designer in your own programs. To do this set up the background, border and multi-colours, choose the character set and turn multi-colour on or off as desired, then use one of the following subroutines to download the desired screen on to the real screen. NB. You must have loaded the screen, character set and colour table beforehand.

BASIC

```
1000 SCREEN = 1024:COLOUR
 = 55296:CTAB = 21504
1010 S2 = 24576:REM
DESIGNED SCREEN
1020 FOR 1 = 0 TO 999
1030 CH = PEEK(S2 + 1)
1040 POKE SCREEN + I,CH
1050 POKE COLOUR + I, PEEK
(CTAB + CH)
1060 NEXT I
1070 RETURN
```

Code Load

```
1000 FORI= 0T045:READA:
POKE49152 +1,A:NEXT
1010 DATA 169,216,133,196,
169,4,133,252
1020 DATA 169,96,133,254,160,
0,132,195
1030 DATA 132,251,132,253,
177,253,145,251
1040 DATA 170,189,0,84,145,
195,200,208
1050 DATA 243,230,196,230,
252,230,254,165
1060 DATA 254,201,100,208,
231,96
```

To download the screen type: SYS 49152 (RETURN)
NB. This program will overwrite any sprite pointers.

Moving blocks of memory

There may be times when you wish to move a character set, screen or even a colour table to a different place in memory. The short program below will do this for you.

```
10 FOR I = 0 TO LL-2
20 POKE DD + I, PEEK (SS + I)
30 NEXT I
```

Where LL is number of bytes to be moved as follows:

Character Set	2048
Screen	1000
Colour table	256

DD = the address you want to move the block to
SS = the address you want to move from (see the Memory Map)

Sprites

If you wish to use sprites in your program, remember to leave room for your sprite data. (The space occupied by a character set can hold the data for 32 sprites). Note also that the space occupied by the ROM image (sets two and three) can't be used for sprite data.

Banking the VIC chip

As mentioned earlier, the VIC II chip can only look at 16K of memory at a time. It usually uses the first 16K of memory. This can cause problems as any character sets or sprites limit the amount of memory available to BASIC.

One solution to this is to move the VIC chip to a different location. The only 16K that is completely free is that from 16384 to 32767.

This is done using the following commands:

```
POKE 56578, PEEK(56578) OR 3
POKE 56576, (PEEK(56576) AND 252) OR 2
```

Now all of the character sets, sprite data, and screen locations will need to have 16384 added to their addresses. The program in the section Moving Blocks of Memory can be used to move the character sets. (See also Programmer's Reference Guide pp 101-102.)

The example sets

Included in the package are two example character sets. The first, ADVENT. SET is a "gothic"-style alphabet together with some characters to make up a picture of the type in many graphic adventures. This loads into the designer at SET 5. The associated colour table and screen are called ADVENT.CLR and ADVENT.SCR respectively. For this set multi-colour mode needs to be on and the multi-colours should be light grey and mid grey.

The second example, which loads at SET 6, is a double-sized alphabet that could be used in an educational program along with a picture of a cuddly toy. The files are called TEDDY.SET, TEDDY.CLR and TEDDY.SCR. To see the picture properly, multi-colour mode has to be switched off. A rather challenging exercise might be to write a program to convert an ASCII string to these double height characters and PRINT or POKE them to the screen.

Bibliography There are many, many books on the market about the Commodore 64, especially concerning graphics. There is only one which is absolutely essential and has been referred to throughout this manual: Commodore 64 Reference Guide, published by Commodore.

Allen Webb doodles with Cheetah's sweet talker and RAT.

CHEETAH SPEAKS OUT

Sweet Talker
£24.95

IN COMMON WITH MANY OTHER products of its type, the **Sweet Talker** speech synthesiser comes in the form of a cartridge. The bonus with this product is taht it is connected to the user port. This means that the cartridge slot is left available. Since the Sweet Talker does not interfere with the operating system, it can be left in place most of the time. The audio output leaves via the audio/video connector.

This package uses the allophone approach to generating speech. This means that rather than having a fixed vocabulary of words, you are given the ability to create a huge range of sounds. This is achieved by splitting speech into 63 sounds or allophones. These are combined, rather like syllables, to create words. The system adopted by Cheetah, however, is somewhat fiddly. Each allophone must be converted to a numerical code and this code used by a machine code routine to create the sound. This means that you must perform the tedious tasks of converting words into allophones and then converting the allophones to data. I have seen better approaches to dealing with this problem.

The clarity of the speech generated by Sweet Talker is good but has a rather mechanical timbre similar to that TV favourite Metal Mickey. The absence of intonation somewhat hinders the flexibility of the system, but the quality is above average. The package comes with a demonstration cassette.

Overall, this is a good product which is worthy of serious consideration.



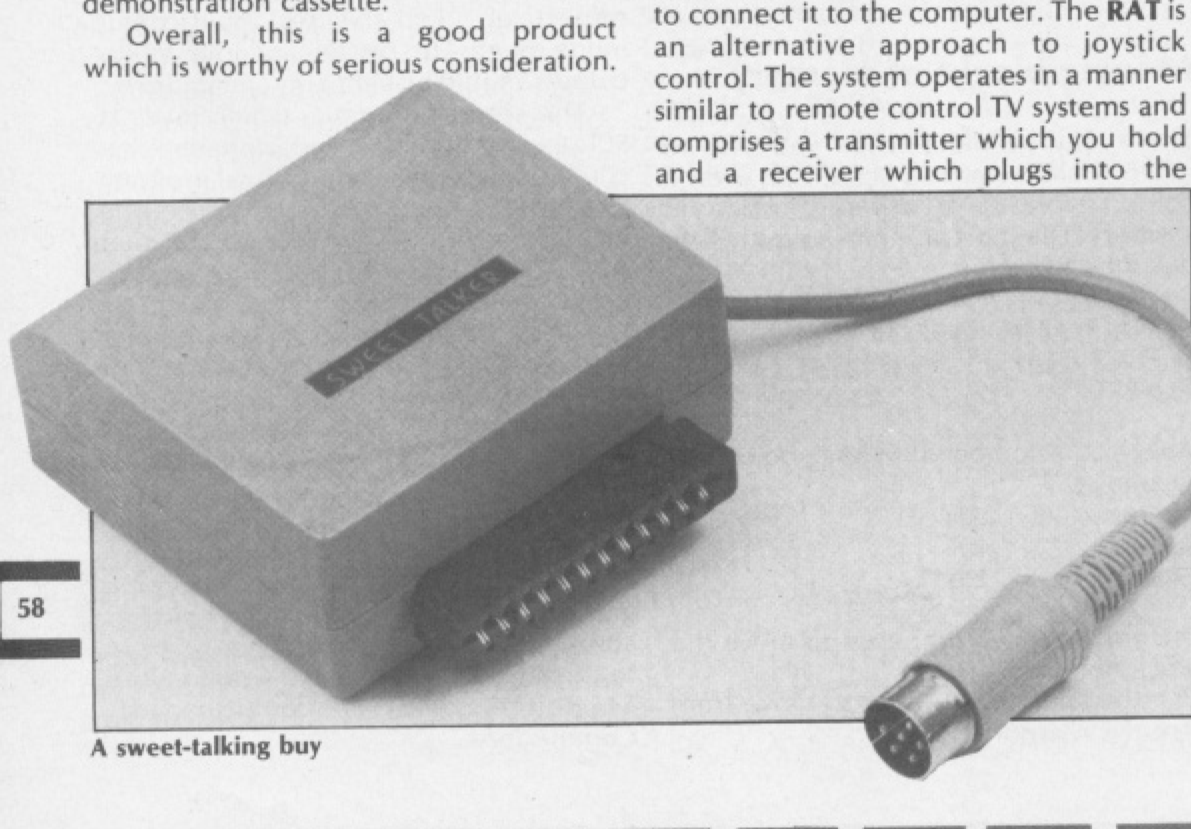
Cheetah gets RATted!

RAT (Remote Action Transmitter)
£29.95
C64

MOST OF US OWN JOYSTICKS AND appreciate the limitations of using a cable to connect it to the computer. The **RAT** is an alternative approach to joystick control. The system operates in a manner similar to remote control TV systems and comprises a transmitter which you hold and a receiver which plugs into the joystick ports. When you press a control on the transmitter, an infra-red signal is sent to the receiver. This is converted into a form which the computer can interpret. The upshot of this is that you can sit in your easy chair and play space invaders on your computer at the other end of the room.

The transmitter is not so much a joystick as a pressure sensitive pad. A disc with eight dimples provides the usual joystick type movement. The dimples are provided to give a tactile reference point so that you know which bit you're pressing. A single pressure pad provides a fire option.

The first obvious impression you get when using the RAT is that it's trickier to use than a joystick. I found it difficult to press a specified position quickly. This was particularly crucial on games such as Impossible Mission which require dexterity. No doubt with a lot of practice it will be possible to achieve sufficient skill on the RAT, but many may find it daunting. Couple this aspect with its high price and you have a product which may have a limited market. This aside, it is a very well-made product which functions faultlessly.



A sweet-talking buy



DOG FIGHT

Can you win the battle of the skies in this high flying game from F.G. Tout.

AS THE ACE PILOT IN control of a spanking new spitfire your aim is to zoom in and destroy the flagging, archaic bi-planes of your enemy. You score 50 points for each plane you blast out of the sky.

There is a timer at the bottom of the screen. When this reaches the right hand side, you will progress to the next level, picking up 1000 points bonus and an extra life.

The joystick must be placed in port 2. Normal joystick movements apply. Press space to return to the title page.

Variables

V	= Video chip
S1, S2, S3	=Sound
X	= Timer
S	= Score
Hi	= High score
Li	= Lives
Le	= Level
Sp	= Speed
Z	= Timer
Co	= Colour

Program Information

Part 1
This is sprite and graphics data

Part 2
This is all machine code

Part 3

5	Set graphics pointer
20	Sound variables
40 - 90	Set sprite position and colours
130	Set variables
135 - 199	Main loop/routine
1000 - 1040	Print score board etc.
2000 - 2015	Crash routine
3000 - 3012	Increase levels
5000 - 5030	Game over
60000 - 60115	Title page
61000 - 61190	Title page music
62000 - 62070	Choose levels
63000 -------	Instructions

Program Listing 1

```
0 CLR:PRINTCHR$(147)CHR$(144)TAB(14)"PLEASE WAIT"
5 W=12288
10 READA:IFA=-1THEN300
15 POKEW,A:W=W+1:DA=DA+1:CH=CH+A:GOTO10
20 DATA 0, 0, 0, 0, 0, 0, 0, 0, 60, 126, 102, 126, 126
22 DATA 102, 102, 0, 120, 124, 102, 60, 102, 124, 120, 0, 28, 62, 118
24 DATA 96, 118, 62, 28, 0, 120, 124, 110, 102, 110, 124, 120, 0, 62
26 DATA 126, 96, 120, 96, 126, 62, 0, 62, 126, 96, 120, 120, 96, 96
28 DATA 0, 28, 62, 112, 111, 118, 60, 28, 0, 38, 102, 126, 126, 102
30 DATA 102, 100, 0, 60, 126, 24, 24, 24, 126, 60, 0, 60, 126, 24
32 DATA 216, 216, 120, 56, 0, 246, 110, 124, 120, 124, 102, 246, 0, 96
34 DATA 96, 96, 96, 114, 126, 62, 0, 34, 119, 127, 107, 99, 99, 119
36 DATA 0, 99, 115, 123, 127, 111, 103, 243, 0, 24, 60, 102, 102, 118
38 DATA 60, 24, 0, 56, 124, 102, 126, 124, 96, 112, 0, 24, 60, 102
40 DATA 102, 118, 62, 27, 0, 56, 124, 102, 126, 124, 108, 102, 0, 60
42 DATA 126, 102, 56, 94, 126, 124, 0, 60, 126, 90, 24, 24, 24, 24
44 DATA 0, 102, 102, 102, 102, 118, 126, 60, 0, 102, 102, 102, 118, 126
46 DATA 60, 24, 0, 99, 99, 107, 127, 127, 119, 99, 0, 99, 119, 62
48 DATA 28, 62, 119, 99, 0, 99, 119, 62, 28, 28, 28, 12, 0, 127
50 DATA 127, 30, 28, 60, 127, 127, 60, 48, 48, 48, 48, 48, 60, 0
52 DATA 12, 18, 48, 124, 48, 98, 252, 0, 60, 12, 12, 12, 12, 12
54 DATA 60, 0, 0, 24, 60, 126, 24, 24, 24, 24, 0, 16, 48, 127
56 DATA 127, 48, 16, 0, 0, 0, 0, 0, 0, 0, 0, 0, 24, 24
58 DATA 24, 24, 0, 0, 24, 0, 102, 102, 102, 0, 0, 0, 0, 0
60 DATA 102, 102, 255, 102, 255, 102, 102, 0, 24, 62, 96, 60, 6, 124
62 DATA 24, 0, 98, 102, 12, 24, 48, 102, 70, 0, 60, 102, 60, 56
64 DATA 103, 102, 63, 0, 6, 12, 24, 0, 0, 0, 0, 0, 12, 24
66 DATA 48, 48, 48, 24, 12, 0, 48, 24, 12, 12, 12, 24, 48, 0
68 DATA 0, 102, 60, 255, 60, 102, 0, 0, 0, 24, 24, 126, 24, 24
70 DATA 0, 0, 0, 0, 0, 0, 0, 24, 24, 48, 0, 0, 0, 126
72 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 24, 24, 0, 0, 3
74 DATA 6, 12, 24, 48, 96, 0, 0, 120, 204, 156, 172, 204, 252, 120
76 DATA 0, 24, 24, 24, 24, 56, 56, 56, 0, 124, 126, 28, 112, 112
78 DATA 126, 62, 0, 124, 126, 28, 112, 124, 6, 124, 0, 64, 96, 96
80 DATA 108, 124, 12, 12, 0, 124, 96, 120, 12, 12, 124, 120, 0, 28
82 DATA 48, 120, 108, 108, 124, 56, 0, 124, 124, 24, 48, 112, 96, 96
84 DATA 0, 120, 204, 204, 120, 204, 204, 120, 0, 120, 204, 236, 124, 12
86 DATA 252, 120, 0, 0, 24, 0, 0, 24, 0, 0, 0, 0, 24, 0
88 DATA 0, 24, 24, 48, 14, 24, 48, 96, 48, 24, 14, 0, 0, 0
90 DATA 126, 0, 126, 0, 0, 0, 112, 24, 12, 6, 12, 24, 112, 0
92 DATA 60, 102, 6, 12, 24, 0, 24, 0, 0, 0, 0, 0, 0, 0
94 DATA 0, 0, 255, 95, 63, 255, 255, 255, 127, 63, 255, 250, 252, 255
96 DATA 255, 255, 254, 252, 255, 250, 252, 239, 239, 247, 250, 252, 63, 95
98 DATA 239, 247, 247, 63, 95, 255, 255, 255, 255, 255, 255, 255, 255, 255
100 DATA 0, 123, 239, 223, 255, 231, 94, 0, 128, 128, 128, 128, 128, 128
102 DATA 128, 128, 192, 192, 192, 192, 192, 192, 192, 192, 224, 224, 224, 224
104 DATA 224, 224, 224, 224, 240, 240, 240, 240, 240, 240, 240, 240, 248, 248
106 DATA 248, 248, 248, 248, 248, 248, 252, 252, 252, 252, 252, 252, 252, 252
108 DATA 254, 254, 254, 254, 254, 254, 254, 254, 255, 255, 255, 255, 255, 255
110 DATA 255, 255, 255, 0, 127, 0, 191, 0, 32, 0, 0, 255, 0, 36
112 DATA 0, 255, 0, 238, 0, 255, 0, 255, 0, 255, 0, 36, 0, 255
114 DATA 0, 101, 0, 255, 0, 255, 0, 110, 0, 117, 0, 255, 0, 102
116 DATA 0, 255, 0, 36, 0, 255, 0, 255, 0, 255, 26, 255, 0, 255
118 DATA 0, 36, 0, 255, 0, 255, 0, 255, 0, 255, 0, 109, 0, 100
120 DATA 0, 36, 0, 100, 0, 255, 0, 100, 0, 255, 0, 255, 0, 255
122 DATA 0, 255, 0, 255, 0, 255, 0, 255, 0, 110, 0, 255, 0, 255
124 DATA 0, 255, 0, 255, 0, 255, 0, 118, 0, 255, 0, 255, 0, 255
126 DATA 64, 255, 0, 255, 0, 255, 0, 111, 0, 110, 0, 255, 0, 164
128 DATA 0, 255, 0, 36, 0, 255, 0, 127, 0, 253, 95, 255, 0, 0
130 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4, 96
132 DATA 0, 4, 240, 7, 228, 248, 127, 254, 255, 240, 63, 127, 231, 254
134 DATA 31, 255, 228, 0, 0, 4, 0, 0, 4, 0, 0, 0, 0, 0
136 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
138 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
140 DATA 0, 0, 0, 0, 32, 0, 0, 32, 0, 6, 47, 240, 15, 127
142 DATA 254, 31, 248, 31, 255, 127, 207, 254, 47, 255, 0, 32, 0, 0
144 DATA 32, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
146 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
148 DATA 0, 8, 0, 0, 28, 0, 0, 255, 128, 0, 28, 0, 0, 54
150 DATA 0, 0, 54, 0, 1, 255, 192, 15, 221, 248, 31, 190, 252, 31
152 DATA 190, 252, 15, 221, 248, 3, 255, 224, 0, 255, 128, 0, 28, 0
154 DATA 0, 28, 0, 0, 28, 0, 0, 28, 0, 0, 127, 0, 0, 247
156 DATA 128, 0, 119, 0, 0, 8, 0, 0, 0, 8, 0, 0, 119, 0
158 DATA 0, 247, 128, 0, 127, 0, 0, 28, 0, 0, 28, 0, 0, 28
160 DATA 0, 0, 28, 0, 0, 62, 0, 3, 255, 192, 15, 237, 240, 31
162 DATA 222, 248, 31, 222, 248, 15, 237, 240, 1, 255, 128, 0, 60, 0
164 DATA 0, 54, 0, 0, 20, 0, 0, 255, 128, 0, 28, 0, 0, 8
166 DATA 0, 0, 1, 128, 0, 115, 0, 0, 126, 0, 0, 63, 128, 0
168 DATA 31, 192, 0, 63, 239, 0, 108, 119, 128, 199, 59, 128, 3, 221
170 DATA 128, 3, 238, 0, 3, 247, 0, 3, 251, 128, 3, 251, 192, 1
172 DATA 235, 224, 0, 1, 240, 0, 0, 255, 0, 0, 127, 0, 0, 47
```

```
174 DATA 0, 0, 30, 0, 0, 0, 0, 0, 0, 0, 0, 0, 240, 0
176 DATA 0, 248, 0, 0, 200, 0, 1, 216, 0, 3, 240, 3, 239, 224
178 DATA 7, 223, 192, 7, 184, 128, 7, 119, 128, 6, 239, 0, 1, 223
180 DATA 128, 7, 191, 128, 15, 191, 128, 223, 191, 0, 127, 192, 0, 63
182 DATA 128, 0, 63, 0, 0, 124, 0, 0, 126, 0, 0, 115, 0, 0
184 DATA 1, 128, 0, 0, 0, 1, 128, 0, 0, 220, 0, 0, 252, 0
186 DATA 1, 248, 0, 3, 248, 3, 239, 236, 7, 223, 198, 7, 184, 130
188 DATA 7, 119, 128, 6, 239, 0, 3, 223, 128, 199, 191, 128, 255, 255
190 DATA 128, 247, 255, 0, 110, 0, 0, 60, 0, 0, 0, 0, 0, 0
192 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 15, 0
194 DATA 0, 31, 0, 0, 22, 0, 0, 27, 0, 0, 15, 128, 0, 7
196 DATA 239, 128, 3, 247, 192, 1, 187, 192, 1, 221, 192, 3, 238, 192
198 DATA 7, 247, 0, 7, 251, 128, 3, 251, 192, 1, 255, 226, 0, 5
200 DATA 246, 0, 3, 252, 0, 1, 248, 0, 0, 248, 0, 0, 124, 0
202 DATA 0, 204, 0, 0, 128, 0, 0, 0, 0, 0, 0, 0, 0, 0
204 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
206 DATA 0, 0, 0, 28, 0, 0, 28, 0, 0, 28, 0, 0, 0, 0
208 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
210 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
212 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
214 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
216 DATA 254, 0, 1, 231, 0, 0, 0, 0, 0, 1, 231, 0, 3
218 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
220 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
222 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
224 DATA 4, 56, 31, 244, 63, 245, 252, 31, 255, 252, 0, 43, 196, 0
226 DATA 21, 4, 0, 36, 132, 0, 127, 192, 16, 36, 132, 56, 21
228 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
230 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
232 DATA 3, 254, 0, 33, 36, 8, 39, 168, 28, 47, 126, 28, 63, 247
234 DATA 252, 63, 255, 248, 39, 219, 192, 32, 148, 0, 33, 18, 0, 3
236 DATA 254, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
238 DATA 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
240 DATA 24, 0, 0, 60, 0, 0, 36, 0, 0, 60, 0, 31, 255, 248
242 DATA 63, 255, 252, 49, 255, 140, 60, 255, 60, 63, 255, 252, 31, 255
244 DATA 248, 0, 60, 0, 0, 60, 0, 0, 60, 0, 0, 60, 0, 0
246 DATA 24, 0, 0, 24, 0, 0, 126, 0, 0, 255, 0, 0, 126, 0
248 DATA 0, 24, 0, 0, 24, 0, 0, 126, 0, 0, 255, 0, 0, 126
250 DATA 126, 0, 0, 24, 0, 0, 60, 0, 0, 60, 0, 0, 60, 0
252 DATA 0, 60, 0, 0, 60, 0, 0, 60, 0, 0, 60, 0, 0, 60
254 DATA 60, 49, 255, 140, 63, 255, 252, 31, 255, 248, 63, 255, 252, 60
256 DATA 36, 0, 0, 60, 0, 0, 24, 0, 0, 255, 0, 0, 27, 0
258 DATA 0, 15, 0, 0, 31, 0, 28, 31, 128, 62, 1, 224, 127, 0
260 DATA 240, 239, 0, 249, 223, 0, 127, 191, 0, 63, 187, 0, 31, 254
262 DATA 0, 63, 236, 0, 127, 248, 0, 255, 240, 1, 255, 248, 3, 157
264 DATA 253, 7, 127, 123, 6, 246, 62, 7, 252, 12, 3, 216, 24, 1
266 DATA 240, 48, 0, 0, 32, 0, 3, 1, 0, 6, 7, 128, 12, 14
268 DATA 224, 28, 29, 240, 63, 187, 240, 103, 251, 208, 199, 255, 240, 7
270 DATA 255, 96, 7, 254, 192, 15, 255, 128, 31, 255, 128, 57, 255, 192
272 DATA 119, 239, 224, 111, 219, 224, 127, 241, 243, 63, 96, 63, 29, 192
274 DATA 31, 7, 128, 30, 0, 0, 30, 0, 0, 24, 0, 0, 0, 0
276 DATA 0, 224, 96, 3, 240, 48, 7, 184, 24, 15, 220, 124, 11, 238
278 DATA 254, 15, 239, 251, 6, 255, 241, 3, 255, 224, 1, 191, 224, 0
280 DATA 255, 240, 0, 127, 248, 0, 255, 156, 1, 251, 238, 1, 239, 246
282 DATA 3, 198, 254, 103, 3, 252, 126, 1, 168, 124, 0, 240, 60, 0
284 DATA 0, 126, 0, 0, 110, 0, 0, 0, 0, 48, 0, 0, 62
286 DATA 0, 0, 30, 0, 0, 62, 3, 128, 127, 30, 192, 243, 63, 99
288 DATA 224, 127, 255, 224, 127, 223, 224, 127, 255, 192, 63, 255, 128, 31
290 DATA 255, 0, 15, 255, 128, 7, 254, 192, 143, 255, 224, 207, 255, 160
292 DATA 127, 127, 224, 56, 63, 224, 56, 31, 192, 12, 15, 128, 6, 7
294 DATA 0, 0, 0,-1
300 W=253*64
310 READA:IFA=-1THEN3000
315 POKEW,A:W=W+1:DA=DA+1:CH=CH+A:GOTO310
400 DATA 0, 0, 0, 0, 0, 0, 12, 0, 0, 63, 192, 3, 255
402 DATA 240, 3, 250, 188, 0, 238, 172, 0, 235, 235, 3, 239, 175, 15
404 DATA 175, 188, 62, 190, 176, 15, 175, 176, 3, 190, 188, 3, 238, 175
406 DATA 0, 239, 172, 3, 235, 176, 15, 170, 188, 3, 239, 240, 0, 255
408 DATA 0, 0, 48, 0, 0, 0, 0, 0, 0, 0, 0, 0
410 DATA 48, 0, 0, 0, 0, 0, 51, 192, 0, 59, 240, 0, 46
412 DATA 172, 192, 251, 236, 0, 239, 188, 3, 238, 176, 62, 190, 192, 15
414 DATA 239, 192, 0, 186, 176, 48, 238, 172, 0, 47, 160, 0, 235, 176
416 DATA 3, 238, 240, 0, 255, 192, 0, 63, 0, 48, 48, 0, 0, 0
418 DATA 12, 0, 0, 0, 0, 0, 0, 0, 0, 12, 0, 0
420 DATA 0, 0, 0, 0, 56, 192, 0, 46, 128, 48, 251, 192, 0, 255
422 DATA 176, 3, 238, 128, 2, 190, 192, 0, 239, 192, 0, 187, 176, 0
424 DATA 238, 128, 12, 63, 0, 0, 235, 128, 0, 238, 192, 0, 63, 0
426 DATA 3, 12, 12, 0, 3, 0, 0, 0, 0, 0, 65,-1
3000 IFDA<2114THENPRINT"TOO LITTLE DATA":END
3005 IFDA>2114THENPRINT"TOO MUCH DATA":END
3010 IFCH<>163756THENPRINT"DATA ERROR":END
3020 POKE198,2:POKE631,13:LOAD
READY.
```

Program Listing 2

```
5 CLR:W=49152
10 READA:IFA=-1THEN350
15 POKEW,A:W=W+1:DA=DA+1:CH=CH+A:GOTO10
20 DATA 173, 0, 220, 201, 123, 208, 6, 169, 1, 141, 251, 0, 96, 201
22 DATA 122, 208, 6, 169, 2, 141, 251, 0, 96, 201, 126, 208, 6, 169
24 DATA 3, 141, 251, 0, 96, 201, 118, 208, 6, 169, 4, 141, 251, 0
26 DATA 96, 201, 119, 208, 6, 169, 5, 141, 251, 0, 96, 201, 117, 208
28 DATA 6, 169, 6, 141, 251, 0, 96, 201, 125, 208, 6, 169, 7, 141
30 DATA 251, 0, 96, 201, 121, 208, 6, 169, 8, 141, 251, 0, 96, 201
32 DATA 107, 208, 9, 169, 1, 141, 251, 0, 141, 252, 0, 96, 201, 106
34 DATA 208, 9, 169, 2, 141, 251, 0, 141, 252, 0, 96, 201, 110, 208
36 DATA 9, 169, 3, 141, 251, 0, 141, 252, 0, 96, 201, 102, 208, 9
38 DATA 169, 4, 141, 251, 0, 141, 252, 0, 96, 201, 103, 208, 9, 169
40 DATA 5, 141, 251, 0, 141, 252, 0, 96, 201, 101, 208, 9, 169, 6
42 DATA 141, 251, 0, 141, 252, 0, 96, 201, 109, 208, 9, 169, 7, 141
44 DATA 251, 0, 141, 252, 0, 96, 201, 105, 208, 9, 169, 8, 141, 251
46 DATA 0, 141, 252, 0, 96, 234, 96, 173, 251, 0, 201, 1, 208, 9
48 DATA 169, 205, 141, 248, 7, 206, 0, 208, 96, 201, 2, 208, 12, 169
50 DATA 208, 141, 248, 7, 206, 1, 208, 206, 0, 208, 96, 201, 3, 208
52 DATA 9, 169, 206, 141, 248, 7, 238, 0, 208, 96, 201, 4, 208, 12
54 DATA 169, 210, 141, 248, 7, 238, 0, 208, 238, 1, 208, 96, 201, 5
56 DATA 208, 9, 169, 204, 141, 248, 7, 238, 1, 208, 96, 201, 6, 208
58 DATA 12, 169, 211, 141, 248, 7, 238, 1, 208, 206, 0, 208, 96, 201
60 DATA 7, 208, 9, 169, 207, 141, 248, 7, 206, 0, 208, 96, 201, 8
62 DATA 208, 12, 169, 209, 141, 248, 7, 206, 0, 208, 238, 1, 208, 96
64 DATA 234, 96, 173, 2, 208, 201, 10, 240, 11, 201, 9, 240, 7, 206
66 DATA 2, 208, 173, 1, 208, 141, 3, 208, 96, 169, 0, 141, 252, 0, 208
68 DATA 141, 2, 208, 173, 1, 208, 201, 251, 240, 7, 238, 2, 208, 201
70 DATA 250, 240, 11, 201, 251, 0, 173, 0, 208, 201, 60, 240, 11, 201, 59, 96
72 DATA 169, 0, 141, 252, 0, 173, 3, 208, 201, 60, 240, 11, 201, 208
74 DATA 141, 3, 208, 96, 173, 3, 208, 96, 169, 0, 141, 252, 0, 173, 240
76 DATA 7, 206, 3, 208, 206, 3, 208, 173, 1, 208, 141, 3, 208, 238, 173
78 DATA 0, 208, 141, 2, 208, 173, 1, 208, 141, 3, 208, 238, 3, 208, 3
80 DATA 208, 201, 220, 240, 11, 201, 221, 240, 7, 238, 3, 208, 173, 3
82 DATA 208, 96, 169, 0, 141, 252, 0, 173, 0, 208, 141, 2, 208, 173
84 DATA 1, 208, 141, 3, 208, 96, 173, 252, 0, 201, 1, 208, 10, 32
86 DATA 54, 193, 234, 234, 234, 32, 87, 194, 96, 201, 2, 208, 13, 32
88 DATA 54, 193, 32, 126, 193, 234, 234, 234, 32, 87, 194, 96, 201, 3
90 DATA 208, 10, 32, 126, 193, 234, 234, 234, 32, 87, 194, 96, 201, 4
92 DATA 208, 13, 32, 126, 193, 32, 90, 193, 234, 234, 234, 32, 87, 194
94 DATA 96, 201, 5, 208, 10, 32, 90, 193, 234, 234, 234, 32, 87, 194
96 DATA 96, 201, 6, 208, 13, 32, 90, 193, 32, 162, 193, 234, 234, 234
98 DATA 32, 87, 194, 96, 201, 7, 208, 10, 32, 162, 193, 234, 234, 234
100 DATA 32, 87, 194, 96, 201, 8, 208, 13, 32, 162, 193, 32, 54, 193
102 DATA 234, 234, 234, 32, 87, 194, 96, 173, 0, 208, 141, 2, 208, 173
104 DATA 1, 208, 141, 3, 208, 169, 0, 141, 252, 0, 96, 169, 128, 141
106 DATA 18, 212, 169, 3, 141, 19, 212, 169, 8, 141, 15, 212, 169, 129
108 DATA 141, 18, 212, 96, 169, 32, 141, 11, 212, 169, 2, 141, 12, 212
110 DATA 169, 2, 141, 8, 212, 169, 33, 141, 11, 212, 96, 173, 5, 208
112 DATA 205, 1, 208, 240, 9, 169, 217, 141, 250, 7, 238, 5, 208, 96
114 DATA 169, 214, 141, 250, 7, 238, 4, 208, 96, 173, 6, 208, 205, 0
116 DATA 208, 240, 9, 169, 215, 141, 251, 7, 206, 6, 208, 96, 169, 216
118 DATA 141, 251, 7, 206, 7, 208, 96, 173, 9, 208, 205, 1, 208, 240
120 DATA 12, 238, 9, 208, 238, 8, 208, 169, 218, 141, 252, 7, 96, 169
122 DATA 215, 141, 252, 7, 234, 234, 234, 206, 8, 208, 96, 173, 10, 208
124 DATA 205, 1, 208, 240, 12, 238, 10, 208, 206, 11, 208, 169, 220, 141
126 DATA 253, 7, 96, 169, 217, 141, 253, 7, 238, 11, 208, 96, 173, 13
128 DATA 208, 205, 1, 208, 240, 12, 169, 221, 141, 254, 7, 206, 12, 208
130 DATA 238, 13, 208, 96, 169, 217, 141, 254, 7, 238, 13, 208, 96, 173
132 DATA 14, 208, 205, 0, 208, 240, 12, 169, 219, 141, 255, 7, 206, 14
134 DATA 208, 206, 15, 208, 96, 169, 217, 141, 255, 7, 238, 15, 208, 96
136 DATA 32, 129, 194, 32, 155, 194, 32, 181, 194, 32, 213, 194, 32, 242
138 DATA 194, 32, 15, 195, 96, 234, 234, 234, 234, 234, 234, 234, 234, 234
140 DATA 234, 234, 234, 234, 234, 32, 0, 192, 32, 108, 194
142 DATA 32, 189, 192, 32, 198, 193, 32, 44, 195, 32, 130, 195, 32, 24
144 DATA 196, 32, 198, 193, 234, 234, 234, 234, 234, 76, 49, 234, 234, 234
146 DATA 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234
148 DATA 234, 234, 173, 30, 208, 201, 130, 208, 5, 169, 1, 141, 253, 0
150 DATA 201, 6, 208, 5, 169, 2, 141, 253, 0, 201, 10, 208, 5, 169
152 DATA 3, 141, 253, 0, 201, 18, 208, 5, 169, 4, 141, 253, 0, 201
154 DATA 34, 208, 5, 169, 5, 141, 253, 0, 201, 66, 208, 5, 169, 6
156 DATA 141, 253, 0, 201, 19, 240, 21, 201, 7, 240, 17, 201, 35, 240
158 DATA 13, 201, 11, 240, 9, 201, 131, 240, 5, 201, 67, 240, 1, 96
160 DATA 169, 1, 141, 52, 3, 96, 234, 234, 234, 234, 234, 234, 234, 234
162 DATA 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234
164 DATA 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234
166 DATA 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 234, 173, 253
168 DATA 234, 234, 234, 234, 32, 136, 196, 169, 0, 141, 15, 208, 96
170 DATA 0, 201, 1, 208, 14, 32, 136, 196, 169, 0, 141, 4, 208
172 DATA 0, 141, 253, 0, 96, 201, 2, 208, 14, 169, 0, 141, 253, 0, 96, 201, 3, 208, 14, 169
174 DATA 32, 136, 196, 96, 0, 141, 253, 0, 96
```

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176 DATA 0, 141, 6, 208, 32, 136, 196, 96, 0, 141, 253, 0, 96, 201
178 DATA 4, 208, 14, 169, 0, 141, 8, 208, 32, 136, 196, 96, 0, 141
180 DATA 253, 0, 96, 201, 5, 208, 14, 169, 0, 141, 10, 208, 32, 136
182 DATA 196, 96, 0, 141, 253, 0, 96, 201, 6, 208, 14, 169, 0, 141
184 DATA 13, 208, 32, 136, 196, 96, 0, 141, 253, 0, 96, 96, 169, 128
186 DATA 141, 4, 212, 169, 45, 141, 5, 212, 169, 4, 141, 1, 212, 169
188 DATA 129, 141, 4, 212, 96, 96, 0, 173, 1, 208, 201, 240, 240, 20
190 DATA 173, 248, 7, 201, 255, 240, 7, 238, 248, 7, 238, 1, 208, 96
192 DATA 169, 253, 141, 248, 7, 96, 96, 201, 255, 240, 10, 141, 8, 208
194 DATA 141, 9, 208, 238, 252, 7, 96, 169, 0, 141, 9, 208, 173, 254
196 DATA 0, 141, 252, 7, 169, 0, 141, 253, 0, 96, 201, 5, 208, 45
198 DATA 173, 253, 7, 141, 254, 0, 169, 245, 141, 253, 7, 173, 253, 7
200 DATA 201, 255, 240, 10, 141, 10, 208, 141, 11, 208, 238, 253, 7, 96
202 DATA 169, 0, 141, 11, 208, 173, 254, 0, 141, 253, 7, 169, 0, 141
204 DATA 253, 0, 96, 201, 6, 208, 45, 173, 254, 7, 141, 254, 0, 169
206 DATA 245, 141, 254, 7, 173, 254, 7, 201, 255, 240, 10, 141, 12, 208
208 DATA 141, 13, 208, 238, 254, 7, 96, 169, 0, 141, 13, 208, 173, 254
210 DATA 0, 141, 254, 7, 169, 0, 141, 253, 0, 96, 96, 234, 234, 234,-1
350 W=51000
355 READA:IFA=-1THEN1000
360 POKEW,A:W=W+1:DA=DA+1:CH=CH+A:GOTO355
400 DATA 169, 80, 141, 20, 3, 169, 195, 141, 21, 3, 96, 169, 49, 141
402 DATA 20, 3, 169, 234, 141, 21, 3, 96,-1
1000 IFDA<1366THENPRINT"TOO LITTLE DATA":END
1010 IFDA>1366THENPRINT"TOO MUCH DATA":END
1020 IFCH<>184367THENPRINT"DATA ERROR":END
1030 POKE198,2:POKE631,13:LOAD

READY.
```

Program Listing 3

```
0 REM"DOGFIGHT BY F G TOUT 1985
4 REM WHT
5 POKE53272,29:POKE53280,2:POKE53281,2:A$="▒—|"
20 S1=54276:S2=54277:S3=54273:POKE2040,204:LI=3
30 GOTO60000
40 POKE2040,204:POKE251,0:POKEV+28,0:FORT=5TO15STEP2:POKEV+T,0:NEXT
90 V=53248:POKEV,160:POKEV+1,160:POKE251,0:POKEV+37,6:POKEV+38,2
99 REM RED WHT BLU
100 POKE53272,29:POKE53280,5:POKE53281,3:A$="▒/▒/▒/"
110 PRINTCHR$(147);:FORT=0TO23:PRINTTAB(29)A$:NEXT
115 V=53248:POKEV+21,255:POKE2041,212:FORT=41TO46:POKEV+T,0:NEXT
120 POKEV+39,9:POKEV+27,255:POKE54296,31:POKE54295,245
121 REM HOM-  3*CRD
122 GOSUB1000:B$="▒▒▒▒":POKE820,0
125 SYS51000:POKEV+40,1
130 X=1984:Z=71:CO=54272:B=0:POKE56325,SP:POKEV+21,NS
135 IFPEEK(253)>0THENS=S+50:POKE253,0
137 IFS>HITHENHI=S
139 REM   3*CRD
140 PRINTB$TAB(32);S:PRINT"▒▒▒"TAB(32);HI
145 POKEX,Z:POKEX+CO,B:Z=Z+1:IFZ>78THENZ=71:X=X+1
150 IFX>2023THEN3000
155 IFPEEK(820)=1THEN2000
199 GOTO135
999 REM HOM-CRD BLU
1000 PRINT"▒▒":PRINTTAB(32)"▒SCORE"
1009 REM   3*CRD
1010 PRINT"▒▒▒"TAB(32)"HI-SC"
1019 REM   3*CRD   3*CRD-  4*CRL
1020 PRINT"▒▒▒"TAB(32)"LIVES";"▒▒▒▮▮▮▮"LI
1029 REM   3*CRD   3*CRD-  4*CRL
1030 PRINT"▒▒▒"TAB(32)"LEVEL";"▒▒▒▮▮▮▮"LE
1040 RETURN
2000 SYS51011:POKE2040,253:POKES1+7,128:POKES2+7,12:POKES3+7,15:POKES1+7,129
2003 POKES1,128:POKES2,46
2004 POKEV+28,1:LI=LI-1:POKES1,0
2005 FORT=PEEK(V+1)TO250STEP2:SYS50335:POKES3,255-T:POKES1,65:POKEV+1,T:NEXT
2007 POKES1+14,128:POKES2+14,45:POKES3+14,20:POKES1+14,129
2010 IFLI<1THEN5000
2015 GOTO40
3000 LE=LE+1:S=S+1000:LI=LI+1:IFLE=2THENX$="2"
3002 IFLE=3THENX$="3"
3004 IFLE=4THENX$="4"
```

```
3006 IFLE=5THENX$="5"
3008 IFLE=6THENLE=1:X$="1"
3009 POKES1,64:POKES2,47:POKES2-1,178
3010 SYS51011:POKES1,65:FORT=0TO10:FORTT=250TO50STEP-10:POKES3,TT-T:NEXTTT,T
3012 GOTO62060
5000 A$="GAME  OVER":POKES1,64:POKES2,46:POKE53281,0:POKE53280,0:PRINTCHR$(147)
5010 FORT=0TO10:PRINTCHR$(19):FORTT=0TO9:PRINTTAB(14)A$:POKES3,TT*T:POKES1,65
5020 POKE646,INT(RND(1)*8):NEXTTT,T
5030 FORT=0TO500:NEXT:GOTO60000
60000 POKE53281,5:POKE53280,5:POKEV+21,0
60034 REM CLR-WHT-  3*CRD
60035 PRINT"□≡■■■
60040 PRINT"             ///     ///   ///
60045 PRINT"          / //   / /    / /
60050 PRINT"         //  /  // /   // /
60055 PRINT"         /   /   /  /  /
60060 PRINT"        //   / //  /  // //
60065 PRINT"        //  // //  / // /
60069 REM   3*CRD  ///// ///// /////
60070 PRINT"■■■
60075 PRINT"        //// /////   ///    / / /////
60080 PRINT"     /       /     / /    /  /   /
60085 PRINT"     //      //   // /   // /   //
60090 PRINT"     /       /    /     /  /   /
60095 PRINT"    ////    //    // // ///// //
60100 PRINT"    //      //   //  / //   / //
60109 REM WHT-CRD //   ///// ///// //   / //
60110 PRINT"≡■ BY F G TOUT:1985:FIRE BUTTON TO PLAY
60115 PRINT"          SPACE FOR INSTRUCTIONS"
61000 S1=54276:S2=54277:S3=54273:POKE54296,31:POKE54295,248
61010 POKES1,64:POKES2,12:POKES2-2,108:POKES1+7,32:POKES2+7,14
61015 POKES1+14,16:POKES2+14,15
61020 READA,D:IFA=-1THENRESTORE:GOTO61020
61030 POKES3,A:POKES3+7,A+5*A:POKES3+14,A:POKES1,69:POKES1+7,39:POKES1+14,39
61035 FORT=0TO24*D:NEXT:POKES1,32:POKES1+7,0:POKES1+14,0:POKE53281,A:POKE53280,A
61080 IFPEEK(56320)=111THENS=0:LI=3:GOTO62000
61085 IFPEEK(197)=60THEN63000
61090 GOTO61020
61100 DATA4,10,6,10,4,4,5,4,6,10,8,10,9,10,8,20
61110 DATA4,10,6,10,4,4,5,4,6,10,8,10,9,10,8,60
61120 DATA12,24,16,14,12,10,12,10,11,6,10,6,11,6,12,20
61130 DATA10,24,12,14,10,12,10,12,9,6,8,6,9,8,10,40
61140 DATA4,10,6,10,4,80,4,10,6,10,4,80
61150 DATA8,24,10,14,8,12,8,12,7,6,6,6,7,8,8,40
61160 DATA4,10,6,10,4,80,4,10,6,10,4,80
61170 DATA4,10,6,10,4,4,5,4,6,10,8,10,9,10,8,20
61180 DATA4,10,6,10,4,80,3,30,4,100
61190 DATA-1,-1,-1
62000 POKE53281,0:POKE53280,0:PRINTCHR$(147):A=1
62005 S1=54276:S2=54277:S3=54273:POKE54296,31:POKES1,64:POKES2,44:POKES2-2,44
62010 A$="PLEASE ENTER LEVEL OF DIFFICULTY (1-5)?":PRINTCHR$(19);A$
62020 FORT=0TO38:POKE55296+T,A:A=A+1:IFA>14THENA=1
62030 POKES3,38-T:POKES1,65:NEXT:POKES1,64
62040 GETX$:IFX$=""THEN62040
62050 IFX$<"1"ORX$>"5"THEN62020
62060 IFVAL(X$)=1THENSP=40:NS=31:LE=1
62062 IFVAL(X$)=2THENSP=35:NS=63:LE=2
62063 IFVAL(X$)=3THENSP=30:NS=127:LE=3
62064 IFVAL(X$)=4THENSP=25:NS=255:LE=4
62065 IFVAL(X$)=5THENSP=20:NS=255:LE=5
62070 GOTO40
63000 PRINTCHR$(147);:POKE53281,0:POKE53280,0
63009 REM BLK
63010 PRINT"■ THE BATTLE FOR THE SKIES IS ON,YOUR    ";
63015 PRINT" SPITFIRE IS ARMED AND READY TO GO,ARE  ";
63020 PRINT" READY TO FIGHT?.YOUR ENEMY IS AFTER YOU";
63025 PRINT" BUT HE COULD ONLY GET SOME VERY OLD    ";
63030 PRINT" BI-PLANES THAT HAVE LONG SINCE HAD     ";
63035 PRINT" THEIR DAY.PLUG YOUR J/S INTO PORT 2 AND";
63040 PRINT" BLAST THOSE PLANES OUT OF THE SKY,SCORE";
63045 PRINT" 50 PTS FOR EACH ONE.GOOD LUCK AND TALLY";
63050 PRINT" HO!....CABBAGE CRATES OVER THE BRINY.  ";
63055 PRINT" THERE IS A TIMER AT THE BOTTOM OF THE  ";
63060 PRINT" SCREEN AND WHEN IT REACHES THE RIGHT   ";
63062 PRINT" HAND SIDE YOU WILL PROGRESS TO THE NEXT";
63064 PRINT" LEVEL AND GET 1000 PTS BONUS + AN EXTRA";
63065 PRINT" LIFE"
63155 PRINT"     SPACE TO RETURN TO TITLE PAGE":POKE198,0:A=1
63160 FORT=55296TO55698+200:POKET,A:A=A+1:IFA>14THENA=1
63165 NEXTT
63200 GETS$:IFS$=""THEN63200
63210 IFS$=" "THEN60000
63220 GOTO63200
```

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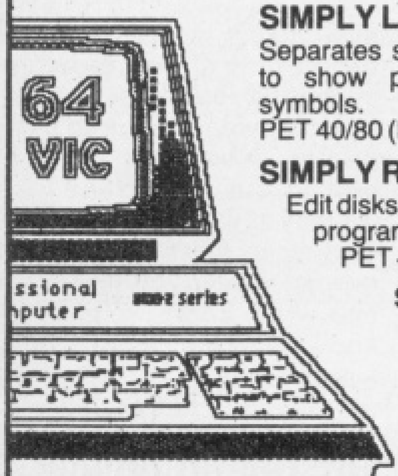
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HI-RES VIC

Nick McCallen's machine code routine will automatically find and assess the character memory and format of a VIC high resolution screen.

IN ORDER TO UNDERSTAND the operation of this routine, some understanding of the relationship between character memory and what appears on the screen is necessary. So, for the benefit of hi-res tyros here a brief explanation.

When the VIC is used in normal (text) mode, each screen location may display a character which is made up of eight rows of dots (pixels). Each pixel row is in fact one byte of the character memory, each of whose bits may be 'on' or 'off' to provide the dots on the screen which make up the character (see Figure 1). Therefore the character memory is made up blocks of eight bytes, each block forming one character. In text mode, these blocks are fixed.

In hi-res mode, a temporary character memory (c.m.) is created in RAM, with all its bits initially 'off' i.e. '0' or blank). Using the techniques outlined below, each bit may be turned on or off by a plotting routine. In order to do this in a controlled manner, each screen location is linked or 'mapped' to a fixed block of bytes in the temporary character memory. Each block may be of eight or sixteen bytes, according to how the VIC is set up.

A common technique of bit-mapping is shown in Listing 1, and results in successive screen locations being mapped to successive c.m. byte-blocks, as illustrated by Figure 2. For the sake of illustration the screen is taken to start at 7680 ($IE00), with the c.m. at 4096 ($1000).

As can be seen, this results in the c.m. bytes being displayed in successive blocks along the screen line. This is easy to achieve, but makes life awkward for a printer with a usable 8×7 matrix, as is the case with many printers run off Commodore computers. To make a printout of hi-res screens easier to obtain on most Commodore, Seikosha and other cheapish dot matrix printers, a different bit mapping technique can be used.

In this alternative method, vertical columns of screen locations are mapped to successive c.m. blocks (see Figure 3 and Listing 2) so that slicing out blocks of seven pixel rows does not demand too much counter juggling. It also eases the solution of another problem: instead of individual bytes representing a horizontal pixel row, the printer expects a byte to represent a VERTICAL column of pixels (see Figure 4). The eighth bit in each printer byte is not actually part of the character block which appears on paper.

There are two other advantages in using this alternative method. Firstly the arrangement of the c.m. is constant whether we use 8×8 or 8×16 character blocks – 8×16 permits use of full screen hi-res. Secondly, in the plotting routine, the Y value is plotted direct, as any increment along this axis corresponds to an identical increment in the c.m. byte number. This reduces the calculations required in the plotting routine, and slightly increases the speed of a very slow BASIC routine.

Now we have to tackle the problem of converting horizontal c.m. bytes to vertical bytes for the printer. This is where the dreaded machine code provides the easiest answer. Included in the 6502 instruction set are instructions which permit rotation of bytes to push the end bit out of a byte into a 'carry' bit. Another instruction can then be used to take the value of this carry and push into the end of another byte (see Figure 5). Using these instructions we can strip one bit at a time off successive c.m. bytes and build them into a vertical byte as required by the printer. Now that we have broken out in machine code, we may as well write the whole routine in machine code: the normal screen dump is slow enough in BASIC, so goodness knows how long a hi-res dump would take!

The Hiprint routine

The routine has been written for maximum flexibility. Avoiding any absolute jumps within the routine means that it can be loaded into any suitably protected part of RAM by the loader provided. Suitable locations for the different configurations possible with VIC are discussed later.

The operational part of the routine starts by finding the temporary character memory start address. The number of

```
10 REM:A TYPICAL BIT MAPPING TECHNIQUE
20 FOR C=0 TO SL:REM SL=NO.OF BYTES TO BE USED ON SCREEN
30 POKE 7680+C,C:REM 7680=SCREEN ORIGIN
40 NEXT C

READY.
```

Listing 1

```
10 REM:ALTERNATIVE METHOD OF BIT MAPPING SCREEN
20 REM:RO=ROW COUNT (E.G.10 ROWS)
30 REM:CL=COLUMN COUNT (E.G.22 COLS.)
40 REM:OS=OFFSET FROM BASE
50 REM:CB=CHARACTER BLOCK
60 SB=7680 :REM:SCREEN BASE
70 FOR RO=0 TO 9:FOR CL=0 TO 21
80 OS=RO*22+CL:REM:CALCULATE SCREEN OFFSET
90 CB=CL*10+RO:REM:CALCULATE ASSOCIATED CHARACTER BLOCK NUMBER
100 POKE SB+OS,CB
110 NEXT CL
120 NEXT RO
READY.
```

Listing 2

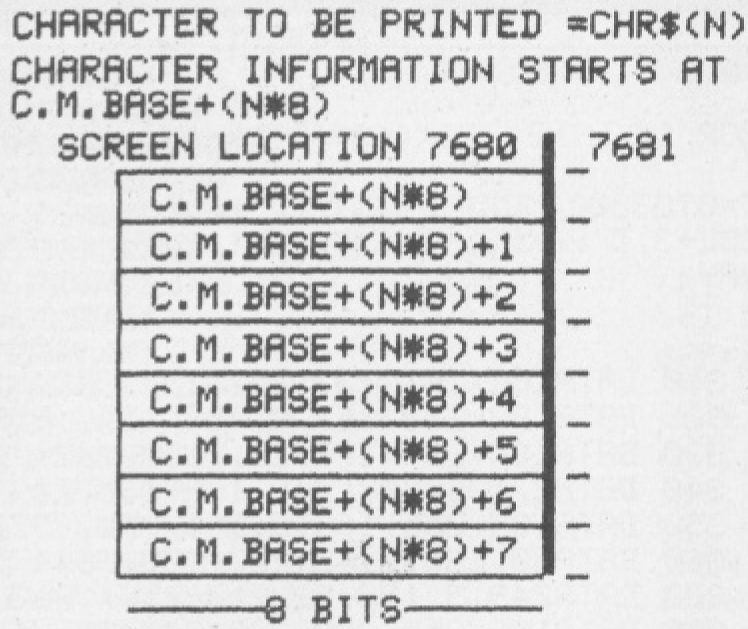


Figure 1 Construction of 8 × 8 characters on screen

SCRN.BASE	+1	+2	+3	....
7680	4096	4097	4098	4099
7702	4118	4119	4120	4121
7724	4140	4141	4142	4143

Figure 2 Bit mapping as in manual

SCRN.BASE	+1	+2	+3	....
7680	4096	4176	4256	4336
7702	4097	4177	4257	4337
7724	4098	4178	4258	4338

Figure 3 Alternative method for Hiprint

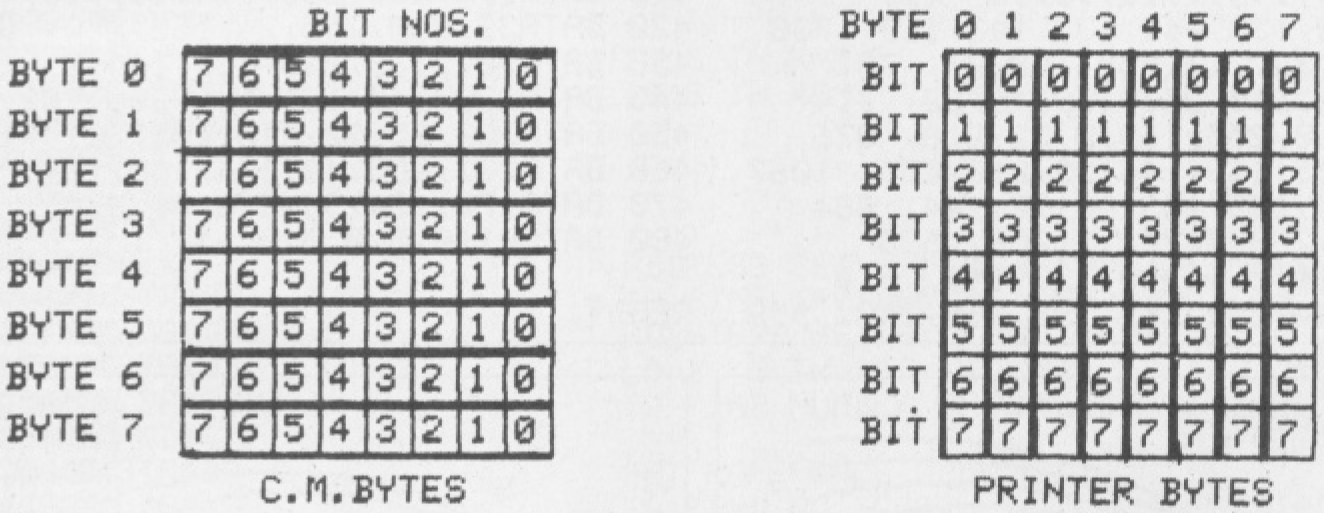


Figure 4 C.M. Bytes compared to printer bytes

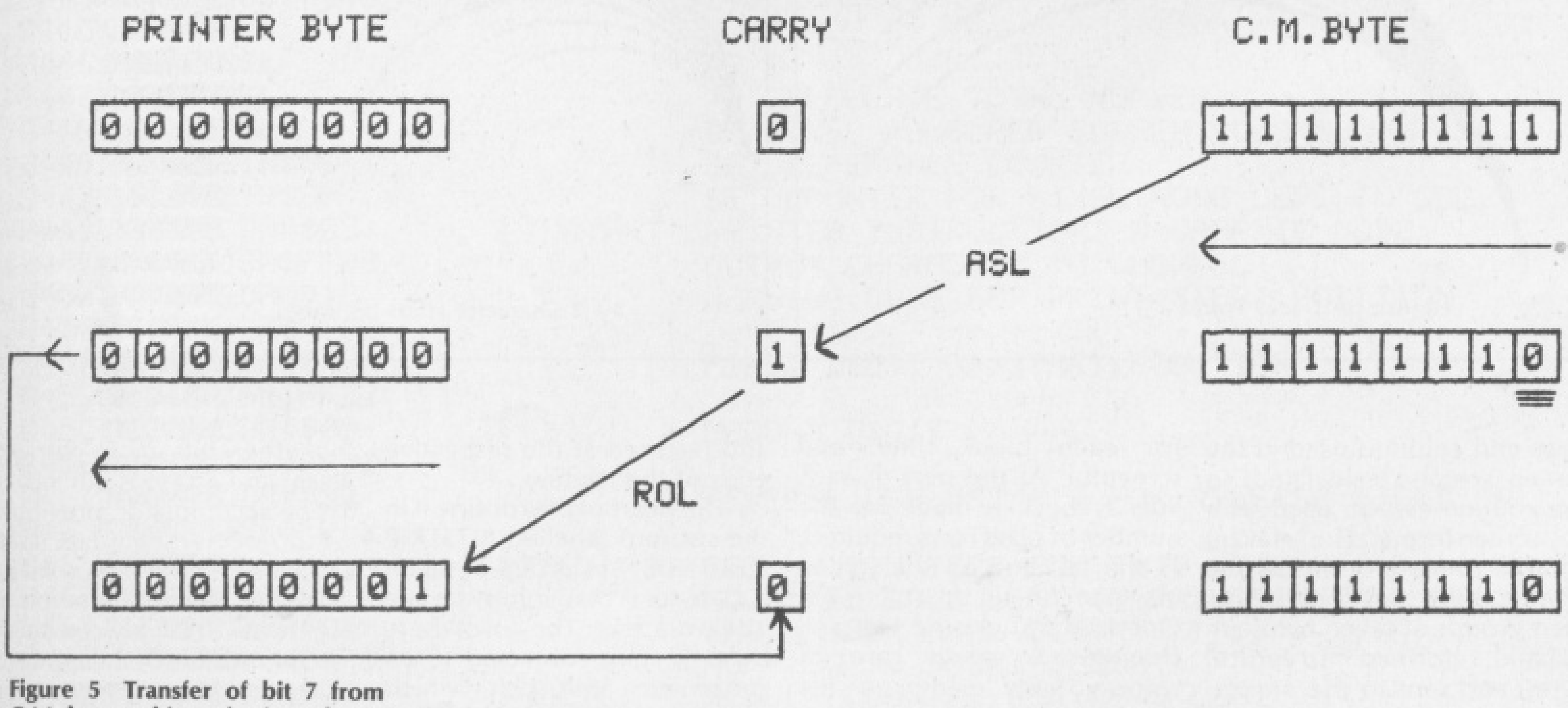
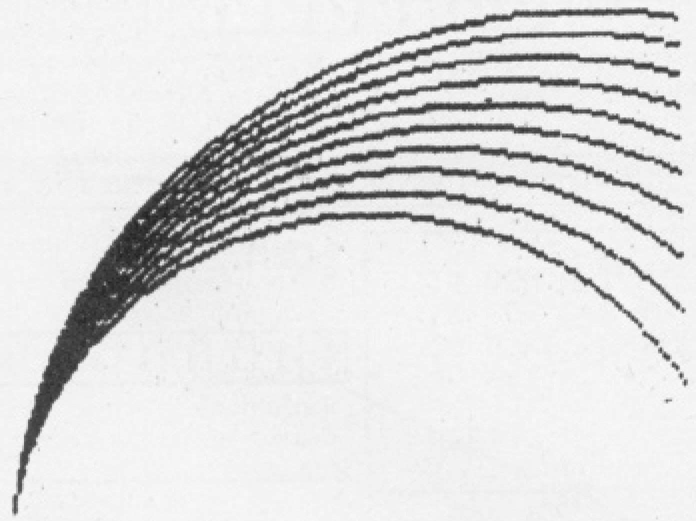


Figure 5 Transfer of bit 7 from C.M. byte to bit 0 of printer byte

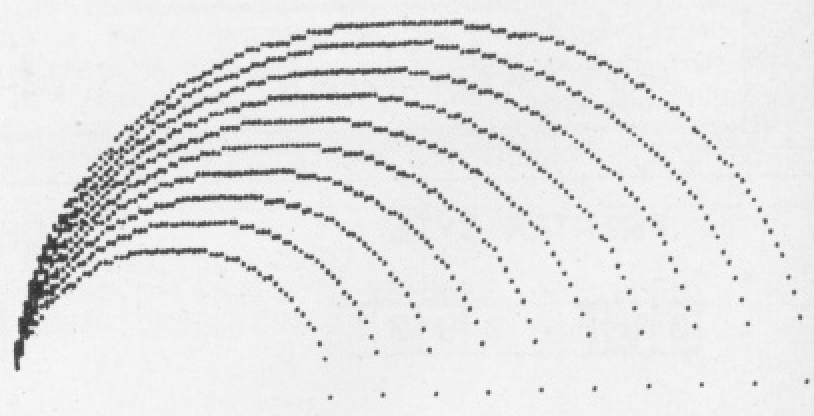
Hiprint Loader

```
10 PRINT"♥ENTER START LOCATION":INPUTSL
20 READA,B,C,D,E,F,G
30 IFA+B+C+D+E+F<>GTHENPRINT"♥DATA ERROR IN LINE"PEEK(63)+PEEK(64)*256:STOP
40 IFA>-1THEN60
50 PRINT"♥DATA CHECKED & ENTERED":FORT=0TO3000:NEXT:PRINT"]":NEW
60 POKESL,A:POKESL+1,B:POKESL+2,C:POKESL+3,D:POKESL+4,E:POKESL+5,F
70 PRINT"LINE"PEEK(63)+PEEK(64)*256"OKAY"
80 SL=SL+6:GOTO20
100 DATA72,138,72,152,72,8, 514
110 DATA169,4,170,160,255,32, 790
120 DATA186,255,169,0,170,168, 948
130 DATA32,189,255,32,192,255, 955
140 DATA162,4,32,201,255,24, 678
150 DATA173,5,144,41,15,201, 579
160 DATA8,176,2,9,32,41, 268
170 DATA39,10,10,170,202,134, 565
180 DATA140,169,255,133,139,173, 1009
190 DATA2,144,41,127,133,141, 588
200 DATA173,3,144,24,41,127, 512
210 DATA74,144,1,10,10,10, 249
220 DATA10,133,142,133,143,169, 730
230 DATA8,32,210,255,169,27, 701
240 DATA32,210,255,169,16,32, 714
250 DATA210,255,169,0,32,210, 876
260 DATA255,169,146,32,210,255, 1067
270 DATA24,165,143,201,7,144, 684
280 DATA6,233,7,162,7,208, 623
290 DATA3,170,169,0,133,143, 618
300 DATA134,254,165,139,166,140, 998
310 DATA164,141,133,251,134,252, 1075
320 DATA132,253,162,0,208,195, 950
330 DATA164,254,177,251,153,160, 1159
340 DATA2,136,208,248,169,8, 771
350 DATA133,255,169,0,166,254, 977
360 DATA30,160,2,42,202,208, 644
370 DATA249,9,128,32,210,255, 883
380 DATA198,255,208,236,24,166, 1087
390 DATA252,165,251,101,142,144, 1055
400 DATA1,232,133,251,134,252, 1003
410 DATA198,253,208,204,169,13, 1045
420 DATA32,210,255,24,165,254, 940
430 DATA101,139,133,139,144,2, 658
440 DATA230,140,165,143,208,182, 1068
450 DATA169,15,32,210,255,32, 713
460 DATA231,255,40,104,168,104, 902
470 DATA170,104,96,0,0,0, 370
480 DATA-1,0,0,0,0,0,-1

READY.
```



Hiprint of 'Tracer Tracks'



8 × 8 Character Hires Printout

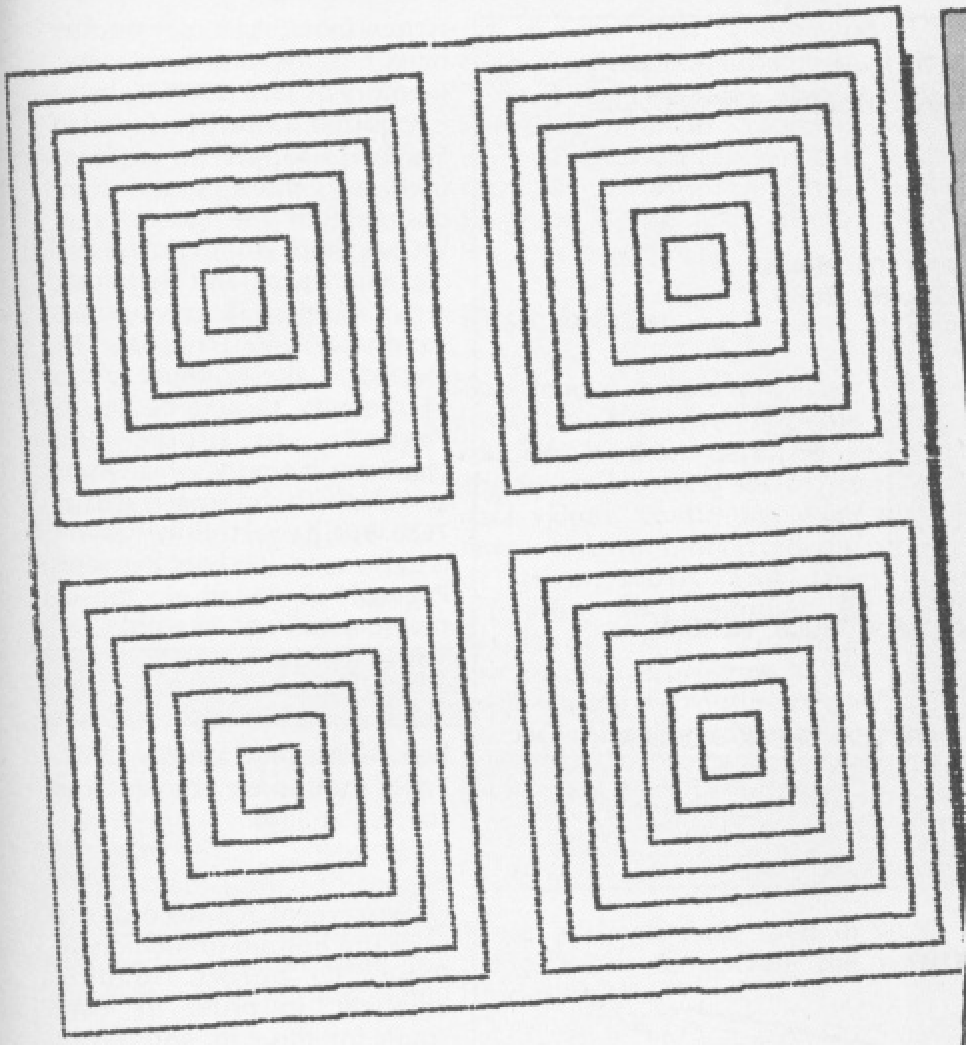
rows and columns used in the screen are also calculated, so the routine can be used with any screen format. The relevant control codes are sent to the printer at the start of each line, then groups of seven bytes are isolated, reformed into vertical bytes, and sent to the printer. Counters are used to ensure the correct number of cycles for each block, line, and screenful. At the start of each line a check is made for the number of pixel rows required, as the last line on the screen may not contain the full seven. Opening and closing files and channels is taken care of with no file name, a file number of 4 and device number 4. Registers are saved and restored at the respective ends of the routine.

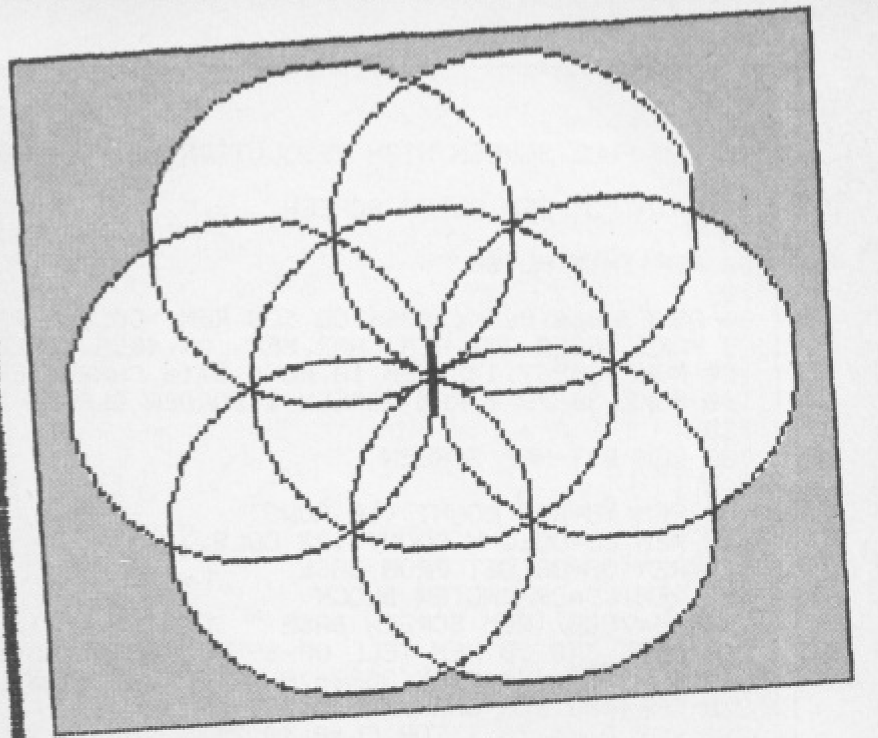
The heart of the routine is in the sections labelled BITSTRIP and STRIPIT. A group of seven c.m. bytes is read into a storage and work area. The last of these bytes is then subjected to an Arithmetic Shift Left, which results in the contents of bit 7 'falling off' into the carry as all the other bits move left one place, and a zero is put into bit 0. The accumulator, previously set to zero, is then subjected to a ROtate Left operation, so that all its bits move left one place. But instead of a zero being forced into bit 0, the contents of the carry are placed there, while the old contents of bit 7 are placed into the carry,

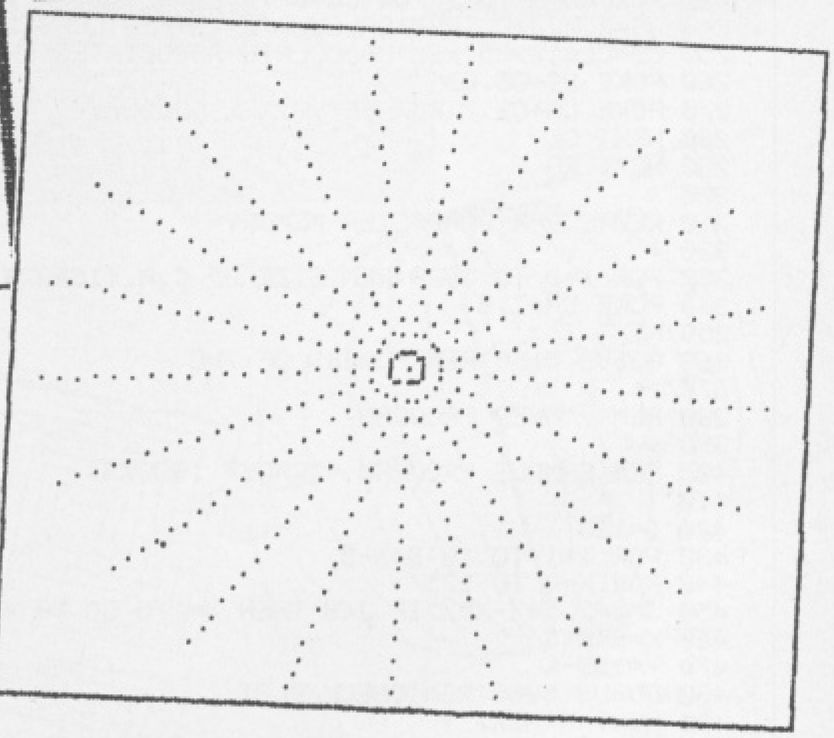
Hiprint Disassembly

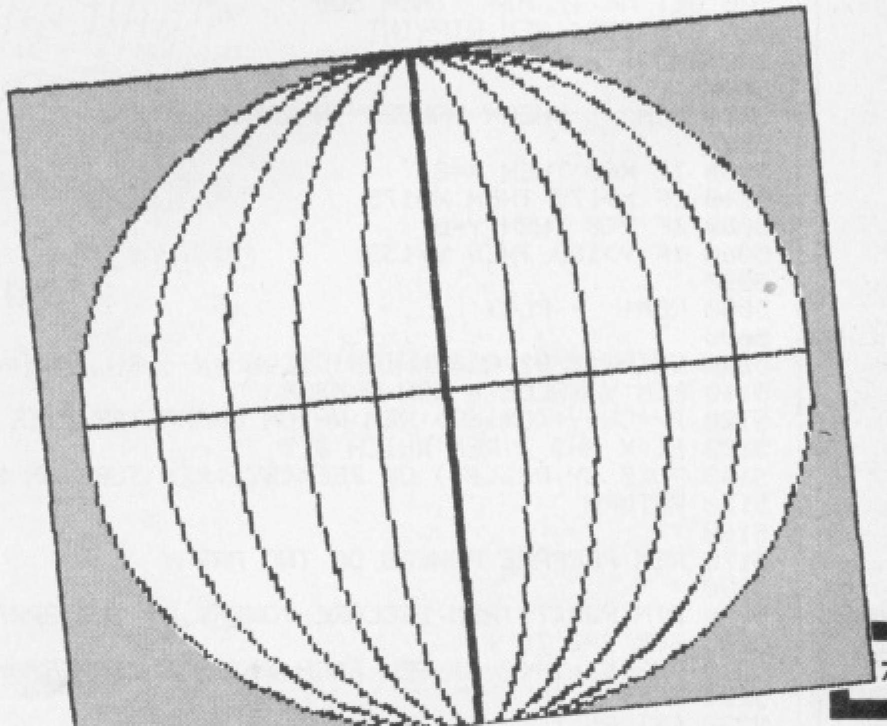
```
,0400[redacted]PHA           PREPARE : SAVE REGISTERS
,0401[redacted]TXA                   :
,0402[redacted]PHA                   :
,0403[redacted]TYA                   :
,0404[redacted]PHA                   :
,0405[redacted]PHP                   :
,0406[redacted]LDA#$04       OPEN    : SET FILE NUMBER
,0408[redacted]TAX                   : SET DEVICE NUMBER
,0409[redacted]LDY#$FF               : $FF=NO SECONDARY ADDRESS
,040B[redacted]JSR$FFBA              : SET LOGICAL/FIRST/SECONDARY ADDRESSES
,040E[redacted]LDA#$00               : FILE NAME;00=NO NAME
,0410[redacted]TAX                   : NO ADDRESS FOR NAME
,0411[redacted]TAY                   : ..
,0412[redacted]JSR$FFBD              : SET FILE NAME INFORMATION
,0415[redacted]JSR$FFC0              : OPEN LOGICAL FILE
,0418[redacted]LDX#$04               : SELECT OUTPUT CHANNEL
,041A[redacted]JSR$FFC9              : OPEN OUTPUT CHANNEL
,041D[redacted]CLC           SCRNINFO: FIND SCREEN FORMAT & CHAR.MEM.LOCATION
,041E[redacted]LDA$9005              : TO FIND C.M.ADDR. HI BYTE
,0421[redacted]AND#$0F               :
,0423[redacted]CMP#$08               :
,0425[redacted]BCS$0429              : IT'S IN RAM
,0427[redacted]ORA#$20               : IT'S IN ROM
,0429[redacted]AND#$27               :
,042B[redacted]ASL                   :
,042C[redacted]ASL                   :
,042D[redacted]TAX                   :
,042E[redacted]DEX                   : ADDRESS SET $01 BELOW ACTUAL VALUE
,042F[redacted]STX$8C                : TO SIMPLIFY USE OF INDEX IN COUNTING
,0431[redacted]LDA#$FF               : POINTERS SET;HI BYTE IN $8C
,0433[redacted]STA$8B                : LO BYTE IN $8B
,0435[redacted]LDA$9002              : TO FIND NUMBER OF COLUMNS
,0438[redacted]AND#$7F               :
,043A[redacted]STA$8D                : SET REFERENCE COUNTER
,043C[redacted]LDA$9003              : TO FIND NO.SCREEN ROWS & CHAR.SIZE
,043F[redacted]CLC                   :
,0440[redacted]AND#$7F               : IF CHARACTERS 8*16 THEN BIT 0=1
,0442[redacted]LSR                   : BIT 0 SHIFTED INTO CARRY
,0443[redacted]BCC$0446              : 8*8 CHARACTERS
,0445[redacted]ASL                   : MULTIPLY BY 16
,0446[redacted]ASL                   : OR 8
,0447[redacted]ASL                   : TO CALCULATE TOTAL NUMBER
,0448[redacted]ASL                   : OF PIXEL ROWS PER SCREEN COLUMN
,0449[redacted]STA$8E                : SET REFERENCE COUNTER
,044B[redacted]STA$8F                : SET COUNTER FOR PIXEL ROWS LEFT IN COL.
,044D[redacted]LDA#$08       LINSTART: PRINTER INSTRUCTIONS 8=GRAPHIC MODE
,044F[redacted]JSR$FFD2              : OUTPUT CHARACTER TO CHANNEL
,0452[redacted]LDA#$1B               : WARNING CODE FOR PRINT START POSITION
,0454[redacted]JSR$FFD2              :
,0457[redacted]LDA#$10               : FIRST DIGIT OF START POSITION
,0459[redacted]JSR$FFD2              :
,045C[redacted]LDA#$00               : SECOND DIGIT
,045E[redacted]JSR$FFD2              :
,0461[redacted]LDA#$92               : REVERSE OFF-USE $12 FOR REVERSE FIELD ON
,0463[redacted]JSR$FFD2              :
,0466[redacted]CLC           LINEINFO: SET UP COUNTERS FOR THIS LINE
,0467[redacted]LDA$8F                : NO.PIXEL ROWS LEFT TO PRINT IN THIS COL.
,0469[redacted]CMP#$07               : ENOUGH FOR FULL BLOCK?
,046B[redacted]BCC$0473              : NO - GO TO SHORT BLOCK
,046D[redacted]SBC#$07       FULLBLK : REDUCE COUNTER FOR ROWS LEFT
,046F[redacted]LDX#$07               : SEVEN ROWS THIS LINE
```

```
,0471[redacted]BNE$0476              : BRANCH TO COUNTSET
,0473[redacted]TAX         SHORTBLK: NO.ROWS THIS LINE
,0474[redacted]LDA#$00              : LAST LINE-NONE LEFT TO PRINT
,0476[redacted]STA$8F      COUNTSET: SET ROWS LEFT
,0478[redacted]STX$FE               : SET ROWS THIS LINE
,047A[redacted]LDA$8B               : GET LINE START ADDRESS
,047C[redacted]LDX$8C               :
,047E[redacted]LDY$8D               : GET NO.COLUMNS IN LINE
,0480[redacted]STA$FB               : SET ADDRESS LO BYTE
,0482[redacted]STX$FC               : SET ADDRESS HI BYTE
,0484[redacted]STY$FD               : SET COLUMN COUNTER
,0486[redacted]LDX#$00              : MAKE SURE NO BRANCH
,0488[redacted]BNE$044D    STAGE    : STEP IN BRANCH FROM 'NEXTLINE'
,048A[redacted]LDY$FE      BLKSTART: SET INDEX TO NO.ROWS THIS LINE
,048C[redacted]LDA($FB),Y  BLKSTORE: GET ONE C.M.BYTE
,048E[redacted]STA$02A0,Y           : SAVE IN WORK AREA
,0491[redacted]DEY                  : DECREMENT INDEX
,0492[redacted]BNE$048C             : IF ANY LEFT GO BACK TO BLKSTORE
,0494[redacted]LDA#$08     BITSTRIP: 8 BITS PER C.M.BYTE
,0496[redacted]STA$FF               : SET BIT COUNTER
,0498[redacted]LDA#$00              : CLEAR ACCUMULATOR FOR NEW PRINTER BYTE
,049A[redacted]LDX$FE               : SET INDEX TO NO.ROWS THIS LINE
,049C[redacted]ASL$02A0,X  STRIPIT  : STRIP NEXT BIT OFF THIS BYTE INTO CARRY
,049F[redacted]ROL                  : ROTATE CARRY INTO ACCUMULATOR
,04A0[redacted]DEX                  : ADJUST INDEX FOR NEXT BYTE
,04A1[redacted]BNE$049C             : IF ANY LEFT THEN STRIPIT
,04A3[redacted]ORA#$80     BYTEND   : PRINTER BYTE ASSEMBLED - SET BIT 7
,04A5[redacted]JSR$FFD2             : OUTPUT TO PRINTER
,04A8[redacted]DEC$FF               : DECREMENT BIT COUNTER
,04AA[redacted]BNE$0498             : IF ANY LEFT THEN GO BACK FOR NEXT
,04AC[redacted]CLC         BLOCKEND: PREPARE FOR NEXT BLOCK
,04AD[redacted]LDX$FC               : GET START ADDRESS OF CURRENT BLOCK
,04AF[redacted]LDA$FB               :
,04B1[redacted]ADC$8E               : ADD NO.ROWS PER COLUMN
,04B3[redacted]BCC$04B6             : TO FIND START ADDRESS OF NEXT BLOCK
,04B5[redacted]INX                  :
,04B6[redacted]STA$FB               : SET ADDRESS POINTERS
,04B8[redacted]STX$FC               :
,04BA[redacted]DEC$FD               : DECREMENT COLUMN COUNTER
,04BC[redacted]BNE$048A    NEXTBLK  : IF ANY LEFT GO BACK TO BLKSTART
,04BE[redacted]LDA#$0D     ENDLINE  : ALL DONE.SEND CARRIAGE RETURN
,04C0[redacted]JSR$FFD2             :
,04C3[redacted]CLC         NEWLINAD: CALCULATE START ADDRESS OF NEXT LINE
,04C4[redacted]LDA$FE               : GET NO.PIXEL ROWS THIS LINE
,04C6[redacted]ADC$8B               : ADD TO LO BYTE OF CURRENT START ADDRESS
,04C8[redacted]STA$8B               : SET LO BYTE OF NEW ADDRESS
,04CA[redacted]BCC$04CE             :
,04CC[redacted]INC$8C               : IF NECESSARY INCREMENT HI BYTE
,04CE[redacted]LDA$8F               : CHECK FOR ROWS LEFT
,04D0[redacted]BNE$0488    NEXTLINE: IF ANY LEFT BAKTHROUGH STAGE TO LINSTART
,04D2[redacted]LDA#$0F     OUT      : NONE LEFT - RESTORE PRINTER TO TEXT MODE
,04D4[redacted]JSR$FFD2             :
,04D7[redacted]JSR$FFE7             : CLOSE FILES & CHANNELS
,04DA[redacted]PLP                  : RESTORE REGISTERS
,04DB[redacted]PLA                  :
,04DC[redacted]TAY                  :
,04DD[redacted]PLA                  :
,04DE[redacted]TAX                  :
,04DF[redacted]PLA                  :
,04E0[redacted]RTS                  : BACK TO BASIC
```









resetting it to zero.

This illustrates the difference between SHIFT and ROTATE operations. Each byte in the storage area has its bit 7 stripped off in this way until the accumulator contains all the bit 7's, i.e. a vertical byte. This byte is sent to the printer, and the process repeated for bits 6,5, and so on until all the seven bytes have been completely stripped. The next block is then read into the work area, and the process starts again.

Each byte sent to the printer sets a column of needles in the print head. Bit 0 sets the top needle, bit 1 sets the next one down, and so on down to 6. Bit 7 is not printed, but must be set to logical (AND $80). Loading the accumulator with zero at the start of each byte assembly simply prevents any stray values appearing in the printout.

Counter locations used

Reference	Working
$8B C.M. Address LO	$FB C.M. Address LO
$8C C.M. Address HI	$FC C.M. Address HI
$8D No. screen columns	$FD Column counter
$8E Total no. pixel rows on screen	$FE Pixel rows in current line
$8F No. pixel rows left to print	$FF Bit counter for shifting

These counters are all in zero page. $8B-$8F are in the RND function work area and $FB-$FF are free locations.

The assembly language listing explains the detailed operation step by step, but one instruction requires further explanation. BNE $0440 at $0488 is an insert to allow a branch back to line start, which would be out of range for a direct branch from $04D0. The alternative is an absolute jump, which would restrict the positional flexibility of the routine.

Hires 1

This is a fully documented program using double-height characters; bit mapping in such a way as to permit use of the Hi-Print routine. This programme will run happily in a Vic with 3K or more expansion.

The screen format is 22 columns of 10 rows, giving 220

```
5 REM
10 :
20 REM:FULL SCREEN HIGH RESOLUTION USING DOUBLE HEIGHT CHARACTERS
30 :
40 PRINT"J":REM:CLEAR SCREEN
50 :
60 REM:INITIALISE
70 :
80 POKE36866,PEEK(36866)OR 128:REM: COLOUR RAM TO 38400
90 POKE 36869,252:REM:CHAR.MEM. AT 4096,SCREEN AT 7680
100 POKE 36867,149:REM:10 ROWS,8*16 CHARACTERS
110 POKE 36879,8:REM:SCREEN & BORDER BLACK
120 :
130 REM:BIT-MAP SCREEN
140 :
150 REM:RO=ROW COUNT (10 ROWS)
160 REM:CL=COLUMN COUNT (22 COLS.)
170 REM:OS=OFFSET FROM BASE
180 REM:CB=CHARACTER BLOCK
190 SB=7680 :REM:SCREEN BASE
200 POKE 648,30:REM:TELL OP-SYSTEM WHERE SCREEN IS
210 CM=37888+4*(PEEK(36866)AND128):REM:START OF COLOUR MEMORY
220 CH=4096:REM:CHAR.MEM.START
230 FOR RO=0 TO 9:FOR CL=0 TO 21
240 OS=RO*22+CL:REM:CALCULATE SCREEN OFFSET
250 CB=CL*10+RO:REM:CALCULATE ASSOCIATED CHARACTER BLOCK NUMBER
260 POKE SB+OS,CB
270 POKE CM+OS,7:REM:SET PIXEL COLOUR.
280 NEXT CL
290 NEXT RO
300 :
310 REM:CLEAR CHARACTER MEMORY
320 :
330 FOR I=0 TO 3520:REM:SIZE OF C.M.(16*22*10)
340 POKE CH+I,0
350 NEXT I
360 GOSUB 5160:REM:POWERS OF TWO
370 :
380 REM:  USER PROGRAM
390 :
400 REM:SAMPLE PROGRAM 'TRACER TRACKS'
410 :
420 B=125
430 FOR T=1 TO 10:B=B-5
440 FOR X=0 TO 175
450 J=B*2.5*X-X*X:IF J<0 THEN X=175:GO TO 490
460 K=SQR(J)
470 Y=159-K
480 GOSUB 5000:REM:CHECK/PLOT
490 NEXT X:NEXT T
500 GET A$:IF A$=""THEN 500
510 SYS 1024:REM:HIPRINT
520 END
5000 :
5010 REM:   CHECK VALUES IN RANGE
5020 :
5030 IF X<0 THEN X=0
5040 IF X>175 THEN X=175
5050 IF Y<0 THEN Y=0
5060 IF Y>159 THEN Y=159
5070 :
5080 REM:    PLOT
5090 :
5100 C=INT(X/8):REM:WHICH COLUMN
5110 REM:Y VALUE = ROW NUMBER
5120 BY=CH+Y+(C*160):REM:WHICH CHARACTER BYTE
5130 BI=X AND 7:REM:WHICH BIT
5140 POKE BY,P2%(BI) OR PEEK(BY):REM:TURN ON SINGLE PIXEL
5150 RETURN
5160 :
5170 REM:PREPARE POWERS OF TWO ARRAY
5180 :
5190 DIM P2%(7):REM:DECLARE POWERS OF TWO ARRAY
5200 FOR B=0 TO 7
5210 P2%(B)=2↑(7-B):REM EACH BIT HAS CORRESPONDING POWER OF TWO
5220 NEXT B
5230 RETURN

READY.
```

Hires 1

screen bytes. As it uses double height characters, a character memory of 3520 (220 × 16) bytes is required. This when added to 506 bytes for screen memory uses up more space than desirable in the unexpanded VIC, as there would not be any room for a program! Therefore, a minimum of 3K expansion is essential. With just 3K expansion the pointers to top of memory should be set to Page 16, to protect the character memory, which starts at 4096, with the screen start at 7680. But, if the Hi-Print routine is to be used, it is kept between Pages 15 & 16, so set top of memory to Page 15 with:

```
POKE 56,15 : POKE 52,15: Clr
```

before loading anything. Hi-Print can then be located starting at 3840.

If using more than 3K expansion (i.e. main RAM above screen), it is necessary to raise the bottom of memory to Page 32 before loading anything, in order to leave room for the c.m. and screen below the program. This is done with

```
POKE 44,32 : POKE 8192,0 : NEW
```

The NEW is needed to reset all BASIC pointers to the new configuration. In this situation the Hi-Print routine can very conveniently be loaded anywhere between 1024 and 4096. In the program as printed, SYS 1024 calls the routine loaded at the bottom of this area. This address can easily be changed by altering the target address in the accompanying loader program.

Neither this program nor the one for the unexpanded VIC are anything spectacular; they are merely demonstrations of technique. They are however sequenced so that bit-mapping and clearing the screen can be observed.

Hires 2

This is a highly condensed and slightly modified version of Hires 1, written to run on the basic VIC. The screen format is reduced to 10 rows × 22 columns and uses 8 × characters. Values used in initialisation and

bit-mapping are obviously different, but the techniques are the same.

Character memory is located at 5120 up, leaving just 1k for the program and Hiprint routine. As the character memory requires 10×22×8 = 1768 bytes, the c.m. ends at 6888, leaving a large enough gap between it and the screen start at 7680 for the Hiprint routine – as long as we are careful not to use any of these locations accidentally when plotting onto the c.m.

A good starting address for the routine in this case would be at the beginning of Page 29 (i.e. 7424). In fact this would permit a few more lines to be used for the hi-res screen.

If using the accompanying loader, it is necessary to set the top of memory pointers to Page 29 by

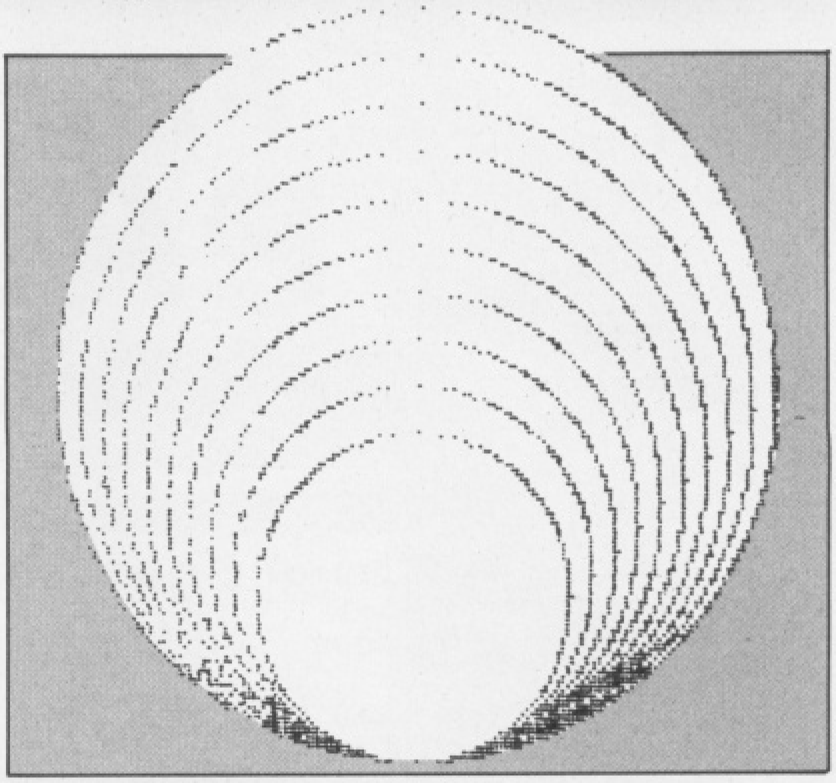
```
POKE 56,29 : POKE 52,29 : Clr
```

The loader is then used to locate the routine, and then the pointers must be reset to Page 20 by the same method.

In both programs, the X range is 0 to (8×no. columns), while the Y (vertical) range is from 0 to (8×no. lines) in Program 2, and 0 to (16×no. lines) in Program 1.

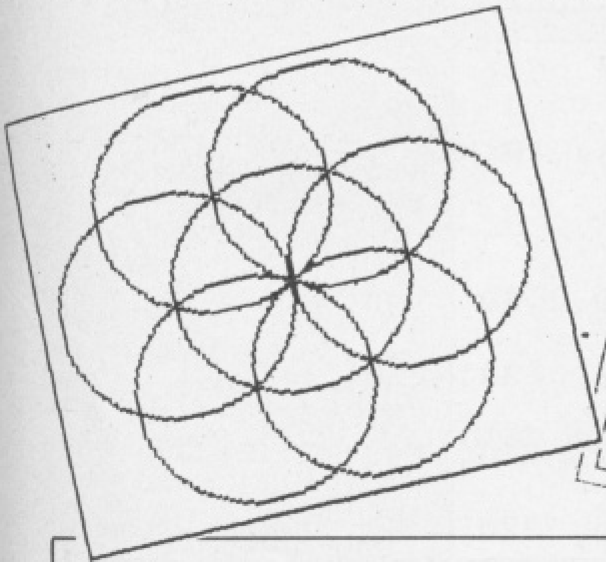
Basic loader

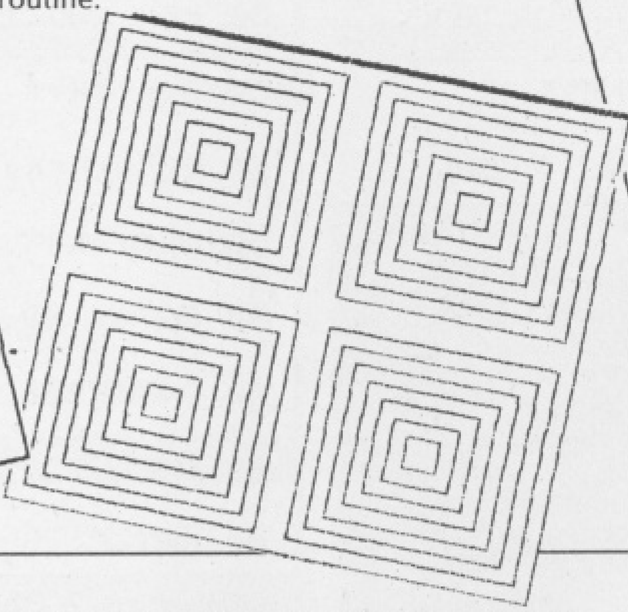
The loader requests a start location for the Hiprint routine. It then performs a checksum for each set of six data values, confirming each line. If an error is detected, the program stops and the offending line number is displayed. After running successfully the program NEWs itself, leaving the routine safely placed in the desired position.

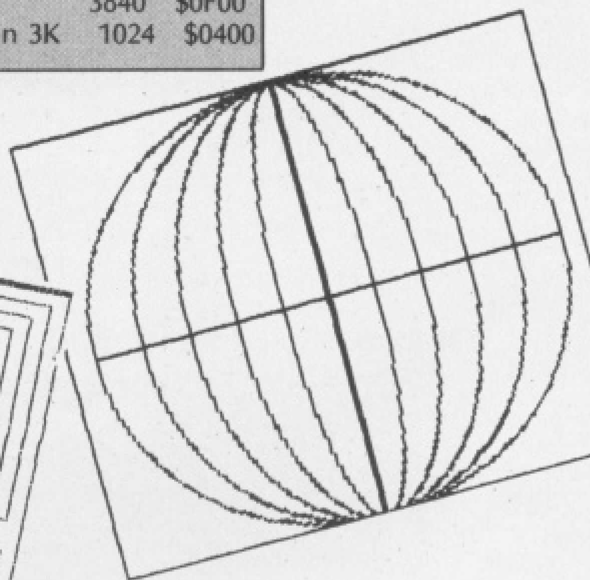


Suggested Start Addresses:			
	Unexpanded VIC	7424	$1D00
	VIC+3K	3840	$0F00
	VIC+more than 3K	1024	$0400

These addresses are used in the SYS call to activate the Hiprint routine.







```
80 PRINT"♥":POKE36869,253:POKE36867,20:POKE36879,8
190 SB=7680:CM=38400:CH=5120
230 FORRO=0TO9:FOR CL=0TO21:OS=RO*22+CL:CB=CL*10+RO
260 POKESB+OS,CB:POKECM+OS,7:NEXTCL:NEXTRO
330 FOR I=0 TO 1760:POKECH+I,0:NEXT
430 B=80:FORT=1TO10:B=B-5:FORX=0TO175:J=B*2.0*X-X*X:IFJ<0THENX=175:GOTO490
460 K=SQR(J):Y=79-K:GOSUB5000
490 NEXTX:NEXTT
500 GETA$:IFA$=""THEN500
510 SYS7424:END
5000 IFX<0THENX=0
5040 IFX>175THENX=175
5050 IFY<0THENY=0
5060 IFY>79THENY=79
5100 C=INT(X/8):BY=CH+Y+(C*80):BI=XAND7:POKEBY,(2↑(7-BI))ORPEEK(BY):RETURN

READY.
```

Hires 2

PROGRAMMING PROJECTS

In this month's project, Garry Marshall shows you how to create a program using animated effects.

PROGRAMS THAT DEPEND on mobile graphics for their fascination and attraction range from games to the better educational programs. Moving graphics are a key feature of all the games of the Space Invaders type that have developed through Pacman to today's sophisticated products. The most notable instance in education where the allure of animation has been used to good effect is Logo. A Logo microworld full of moving shapes is a perfect test-bed for learning about the laws of motion, gravity and many other topics.

The solution

The 64 can maintain up to eight sprites, and we want each to move around on the screen in its own way. By writing a subroutine for moving each sprite we can write a main program that calls each subroutine in turn. Then the program can continually cycle round the eight subroutines to keep the eight sprites moving. Remembering that the sprites are numbered from 0 to 7, this will give us the heart of our program as in Listing 1.

```
240 FOR K=0 TO 7
250 ON K+1 GOSUB 500, 1000, 1500, 2000, 2500, 3000, 3500,
4000
260 NEXT K
270 GOTO 240
```

Listing 1

Here, the loop variable, K, ranges through the sprite numbers. The next line calls the subroutine starting at line 500 when K is 0 to move sprite 0, the subroutine starting at line 1000 when K is 1 to move sprite 1, and so on. When all eight sprites have been moved, line 270 sends the computer back to the beginning of the loop to do it all again.

There is a neater way of doing this. If we store the line numbers at the start of the subroutines for moving sprites 0 to 7 in elements 0 to 7 of an array named say, M, we can enter Listing 2.

```
240 FOR K=1 TO 7
250 GOSUB M(K)
260 NEXT K
270 GOTO 240
```

Listing 2

Unfortunately, this doesn't work (on my 64 [illegible]st) despite assurances from the manual and any number of handbooks that it should.

Having started, in the middle of the program, we must now work our way outwards. We shall begin by going towards the beginning of the program to create the sprites and put them in their

```
10 DIM H(7), C(7), R(7)
20 FOR K=0 TO 7
30 H(K)=K+7
40 READ C(K), R(K)
50 NEXT K
60 DATA  60,  60, 140,  60
70 DATA 220,  60, 220, 140
80 DATA 220, 220, 140, 220
90 DATA  60, 220,  60, 140
```

Listing 3

```
100 PRINT "♥"
120 FOR K=0 TO 60 STEP 3
130 POKE 832+K, 1: POKE 832+K+1, 1: POKE 832+K+2, 0
140 IF K=18 THEN POKE 832+K, 255: POKE 832+K+1, 255: POKE
832+K+2, 255
150 IF K=39 THEN POKE 832+K, 255: POKE 832+K+1, 255: POKE
832+K+2, 255
160 NEXT K
```

Listing 4

initial positions. Then we can complete the program by writing the subroutines for moving the sprites.

The eight sprites will each have their own colour and, when they are first displayed, a position. Each position can be fixed by giving a column and a row. To represent the colours and positions we can use three parallel arrays, as shown in Figure 1. The arrays H, C and R will hold, respectively, the Hues, initial Columns and initial Rows for the sprites. The hue, column and row for sprite K will be held in element K of the relevant array.

To give the sprites the initial positions shown in Figure 2, we start the program with Listing 3.

After this, we make the program clear the screen and, leaving a gap in the line numbering to fill later with initialisations for the subroutines, we store a sprite description to be shared by all the sprites. We have described the mechanics of sprite descriptions in an earlier project, and using the same description for a hash-shaped sprite that we used before gives us Listing 4.

Now, with the sprite description stored, we can associate it with all eight sprites by making the eight locations starting at the one with address 2040 point to it. We give the sprites their colours by copying the colour codes from the array H to the block starting at 53287 and, similarly, give them their initial positions by transferring the column and row numbers from the arrays C and R to the block from 53248 to 53263. This is done by Listing 5.

```
170 FOR J=0 TO 7
180 POKE 2040+J, 13
190 POKE 53278+J, H(J)
200 POKE 53248+2*J, C(J)
210 POKE 53249+2*J, R(J)
220 NEXT J
```

Listing 5

Even now, the sprites won't appear, because we must turn them on. This can be done for all the sprites with:

230 POKE 53269, 255

Running the part of the program consisting of lines 10 to 230 will show the eight coloured sprites in their initial positions. (If you include lines 240 to 270, though, you will get an error message, for we haven't got round to writing the subroutines which they call yet). If you want to test the whole thing up to line 270, you can include 'dummy' subroutines that do absolutely nothing except establish that the structure of the program is alright by adding a series of lines such as:

500 RETURN
1000 RETURN

and so on up to

4000 RETURN

Now we had better replace these empty subroutines with routines that will actually move the sprites. We shall not write all eight, but just those for the odd-numbered sprites to make them move along the paths that are indicated on Figure 2.

Sprite number 1 is to move up and down along a vertical path, bouncing off imaginary barriers at each end. This means that it stays in the same column all the time, so we need not change that.

Its row must keep changing, though. If we store the amount by which it changes under YS and initialise YS in line 110, along with other variables for the other subroutines, then the subroutine must take the row position of sprite 1 from location 53251, add the contents of YS to it, and put the new value back. This will automatically move the sprite to the new position.

The only other thing that we need to do is to test whether the sprite has reached the 'wall' at one end or the other and, if it has, to change the sign of the number stored in YS to make the sprite bounce back. Since the subroutine for sprite 1 starts at line 1000, this gives us Listing 6.

The subroutine for sprite 3 follows the same lines. See Listing 7.

The path for sprite 7 is a circle centred at (140,140) with radius 80. This means that for any value of an angle T the point (140-80★cos(T), 140+80★sin (T)) is on this circle, and as the value of T increases the corresponding point moves

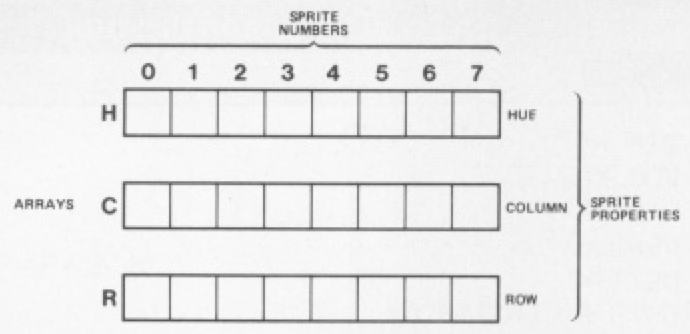


Figure 1. The parallel arrays used to initialise the sprites

```
110 YS=10: XS=5: T=0: A=0

1000 Y=PEEK(53251)
1010 Y=Y+YS
1020 POKE 53251, Y
1030 IF Y>220 OR Y<60 THEN YS=-YS
1040 RETURN
```

Listing 6

```
2000 X=PEEK(53254)
2010 X=X+XS
2020 POKE 53254, X
2030 IF X>220 OR X<60 THEN XS=-XS
2040 RETURN
```

Listing 7

```
4000 T=T+π /50
4010 IF T>=2*π THEN T=0
4020 X7=140-80*COS(T): Y7=140+80*SIN(T)
4030 POKE 53262, X7: POKE 53263, Y7
4040 RETURN
```

Listing 8

```
3000 A=A+π /25
4010 IF A>=2*π THEN A=0
4020 X5=140+40*SIN(-A): Y5=140+80*COS(-A)
4030 POKE 53258, X5: POKE 53259, Y5
4040 RETURN
```

Listing 9

anti-clockwise around the circle. Also, T=0 will give the initial position of sprite 7. So, with T initialised to 0 in line 110, we can move sprite 7 round its circular path with Listing 8.

Although the path of sprite 5 is an elliptical one, the sprite can be sent along it in much the same way by Listing 9.

It is left to you to write subroutines to move the even-numbered sprites. The listing of the program as far as we have developed it is given in Program 1.

Moving on

At this stage, we can take developments a little further by turning off the even-numbered sprites, since there is as yet no way to move them, and use the 64's sprite collision detection to turn them on again. This will illustrate how the collision detection works, and in so doing will provide the basis on which some spectacular effects can be built. For instance, it can be elaborated so that when two sprites collide one of them is wiped out or, perhaps, a new one is born.

At the start of the program, we can use another array, Q, parallel to the arrays for the hues, columns and rows, to record which sprites are initially on and which off. Its element K records that sprite K is on by containing a 1 and that it is off by holding a 0. The array can be declared, initialised to show that only the odd-numbered sprites are on, and then used to turn just these sprites on with the amendments and insertions in Listing 10.

We can then use the array Q to ensure that the program only bothers to try to move sprites that are on by adding the following line to the central movement monitoring section of the program.

```
245 IF Q(K)=0 THEN 260
```

Now, the sprite collisions are recorded in location 53278. What happens, for example, is that when sprites 3 and 5 collide, bits 3 and 5 in this location are set. It is also important to remember that the act of PEEKing at this

Program Listing 1

```
10 DIM H(7), C(7), R(7)
20 FOR K=0 TO 7
30 H(K)=K+7
40 READ C(K), R(K)
50 NEXT K
60 DATA 60,60,140,60
70 DATA 220,60,220,140
80 DATA 220,220,140,220
90 DATA 60,220,60,140
100 PRINT "J"
110 YS=10: XS=5: T=0: A=0
120 FOR K=0 TO 60 STEP 3
130 POKE 832+K, 1: POKE 832+K+1, 1: POKE 832+K+2, 0
140 IF K=18 THEN POKE 832+K, 255: POKE 832+K+1, 255: POKE 832+K+2, 255
150 IF K=39 THEN POKE 832+K, 255: POKE 832+K+1, 255: POKE 832+K+2, 255
160 NEXT K
170 FOR J=0 TO 7
180 POKE 2040+J, 13
190 POKE 53287+J, H(J)
200 POKE 53248+2*J, C(J)
210 POKE 53249+2*J, R(J)
220 NEXT J
230 POKE 53269, 255
240 FOR K=0 TO 7
250 ON K+1 GOSUB 500,1000,1500,2000,2500,3000,3500,4000
260 NEXT K
270 GOTO 240
500 RETURN
1000 Y=PEEK(53251)
1010 Y=Y+YS
1020 POKE 53251, Y
1030 IF Y>220 OR Y<60 THEN YS=-YS
1040 RETURN
1500 RETURN
2000 X=PEEK(53254)
2010 X=X+XS
2020 POKE 53254, X
2030 IF X>220 OR X<60 THEN XS=-XS
2040 RETURN
2500 RETURN
3000 A=A+π/25
3010 IF A>=2*π THEN A=0
3020 X5=140+40*SIN(-A): Y5=140+80*COS(-A)
3030 POKE 53258, X5: POKE 53259, Y5
3040 RETURN
3500 RETURN
4000 T=T+π/50
4010 IF T>=2*π THEN T=0
4020 X7=140-80*COS(T): Y7=140+80*SIN(T)
4030 POKE 53262, X7: POKE 53263, Y7
4040 RETURN
```

```
254 Z1=PEEK(53278)

256 IF Z1<>0 AND Z1<>Z THEN GOSUB 5000

258 Z=Z1
```

Listing 12

```
10 DIM H(7), C(7), R(7), Q(7)
15 P=0
45 Q(K)=K-2*INT(K/2)
46 IF Q(K)<>0 THEN P=P+2^K
230 POKE 53269, P
```

Listing 10

```
5000 S=0
5010 FOR L=0 TO 7
5020 IF Q(L)=0 THEN W=L: S=1
5030 NEXT L
5040 IF S=0 THEN RETURN
5050 Q(W)=1: POKE 53269, PEEK(53269) OR 2^W
5060 RETURN
```

Listing 11

location clears it. Since all we want to do at the moment is to use any collision to trigger the turning on of another sprite, we could add the line.

255 IF PEEK(53278)<>0 THEN GOSUB 5000

This will test and clear the location that records the collisions after each individual sprite movement, calling a subroutine to turn on another sprite if a collision has just occurred. All the subroutine has to do is to scan the array Q to find a sprite that is off, and then update Q and turn the sprite on. This can be done by Listing 11.

Actually, the way that the subroutine is triggered is not entirely satisfactory. This is because once two sprites meet they can stay in contact for some time. Although the collission is recorded when they first meet, the act of PEEKing the collision register clears it, and if the sprites are still in contact the next time around, the collision is recorded again. For this reason, the meeting of one pair of sprites can be recorded several times as a collision and, correspondingly, will turn on several sprites. This is not exactly what we wanted. To avoid it, we must replace line 255, using a more stringent test. In effect, we must say "Has a collision occurred, and is it a different collision from the last one?". We can do this by adding

235 Z=PEEK(53278)

to clear the collision register in the first place. Then we should replace line 255 with Listing 12. The complete program is listed in Program 2.

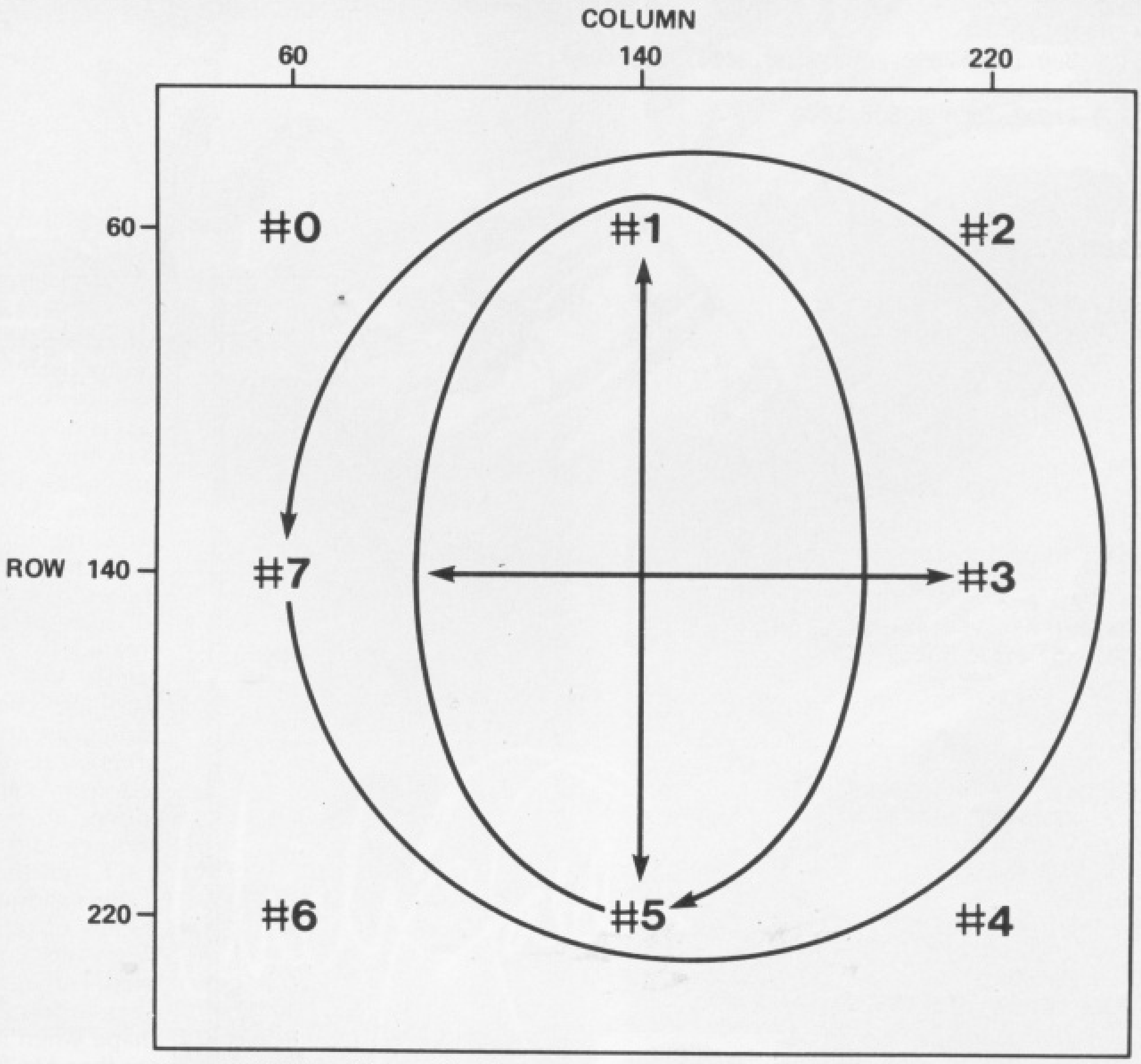


Figure 2. Initial positions and paths for the sprites.

Program Listing 2

```
10 DIM H(7), C(7), R(7), Q(7)
15 P=0
20 FOR K=0 TO 7
30 H(K)=K+7
40 READ C(K), R(K)
45 Q(K)=K-2*INT(K/2)
46 IF Q(K)<>0 THEN P=P+2↑K
50 NEXT K
60 DATA 60,60,140,60
70 DATA 220,60,220,140
80 DATA 220,220,140,220
90 DATA 60,220,60,140
100 PRINT "J"
110 YS=10: XS=5: T=0: A=0
120 FOR K=0 TO 60 STEP 3
130 POKE 832+K, 1: POKE 832+K+1, 1: POKE 832+K+2, 0
140 IF K=18 THEN POKE 832+K, 255: POKE 832+K+1, 255: POKE 832+K+2, 255
150 IF K=39 THEN POKE 832+K, 255: POKE 832+K+1, 255: POKE 832+K+2, 255
160 NEXT K
170 FOR J=0 TO 7
180 POKE 2040+J, 13
190 POKE 53287+J, H(J)
200 POKE 53248+2*J, C(J)
210 POKE 53249+2*J, R(J)
220 NEXT J
230 POKE 53269, P
235 Z=PEEK(53278)
240 FOR K=0 TO 7
245 IF Q(K)=0 THEN 260
250 ON K+1 GOSUB 500,1000,1500,2000,2500,3000,3500,4000
254 Z1=PEEK(53278)
256 IF Z1<>0 AND Z1<>Z THEN GOSUB 5000
258 Z=Z1
260 NEXT K
270 GOTO 240
500 RETURN
1000 Y=PEEK(53251)
1010 Y=Y+YS
1020 POKE 53251, Y
1030 IF Y>220 OR Y<60 THEN YS=-YS
1040 RETURN
1500 RETURN
2000 X=PEEK(53254)
2010 X=X+XS
2020 POKE 53254, X
2030 IF X>220 OR X<60 THEN XS=-XS
2040 RETURN
2500 RETURN
3000 A=A+π/25
3010 IF A>=2*π THEN A=0
3020 X5=140+40*SIN(-A): Y5=140+80*COS(-A)
3030 POKE 53258, X5: POKE 53259, Y5
3040 RETURN
3500 RETURN
4000 T=T+π/50
4010 IF T>=2*π THEN T=0
4020 X7=140-80*COS(T): Y7=140+80*SIN(T)
4030 POKE 53262, X7: POKE 53263, Y7
4040 RETURN
5000 S=0
5010 FOR L=0 TO 7
5020 IF Q(L)=0 THEN W=L: S=1
5030 NEXT L
5040 IF S=0 THEN RETURN
5050 Q(W)=1: POKE 53269, PEEK(53269) OR 2↑W
5060 RETURN

READY.
```

Further developments

There are obviously plenty of ways to take these ideas and build them into all sorts of programs. The immediate extensions and improvements that can be made include the following.

- New subroutines for moving the sprites can be introduced. The paths that they can follow are unlimited, but the introduction of a random element can give interesting effects as can the use of a path that depends on the positions of the other sprites.



- A larger part of the screen can be used for movement. To store column positions in excess of 255 requires more than one eight-bit location, and it is possible to use location 53264 to hold one extra bit for the column position of each of the eight sprites.
- All sorts of effects can be created by making sprites vanish and disappear on particular cues. If all eight sprites are turned on the program should be prevented from calling the subroutine to try and turn on another, first, because it can't and, second, because it slows the program down.
- Sprites of different shapes, sizes and colours can be used. Perhaps a sprite could be transformed to another shape when it collides with another one.


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Mastering Machine Code

A.P. and D.J. Stephenson tackle the problem of using machine code to sort string arrays into order.

SORTING STRINGS IS MORE DIFFICULT than sorting numbers because of the manner in which the BASIC interpreter stores strings. But, it is no good writing, or even attempting to write, a machine code string sort until the storage mechanism is thoroughly understood.

String descriptors

Strings are controlled by string descriptors which consist of three bytes as shown in Figure 10.1. The first byte holds the string length and refers to the number of bytes occupied by the string which, of course, is the same as saying the number of characters in the string. This shows why the number of characters BASIC allows in one string is restricted to 255. The highest number possible in any byte, including the string length byte, is 255. The other two bytes in the string descriptor give the string address (in the form of low-byte, high-byte) where the strings are stored. They are merely address pointers, not the strings themselves. The actual string, consisting of the equivalent ASCII codes, is stored in sequential memory locations, starting at the address given by the address pointer in the string descriptor.

String length	String pointer	
	L byte	H byte

Increasing memory →

Figure 10.1 Keeping strings under control

Thus, in the part of a sort routine where two strings have to be swapped (because they happen to be in the wrong order), we swap over the descriptors rather than the strings themselves. When sorting, then, it is only necessary to ensure that the string descriptors are in order. The strings themselves can be left in exactly the same haphazard order they were in before the sort process began. This will clearly reduce the execution time of the sort. In effect, we are tricking the BASIC interpreter by rearranging its string array access table (a collection of string descriptors).

How string arrays are stored

A string array is a collection of separate strings, sheltering under a common name. We would therefore expect the format for handling string arrays to be more complicated than simple strings because it must cater, not only for the array name, but also for the number of dimensions in the array together with the array size. However, string arrays are handled in a similar way to integer arrays. See Figure 10.2.

Bytes 1 and 2

These are reserved for the array name. In order for the interpreter to distinguish string arrays from integer or floating point arrays, the first byte is the ASCII code of the first character of the array name. (You will remember from last month's discussion, that the first byte in the integer array format is the ASCII code + $80.) The second byte is either the second character of the array name + $80 or, if there isn't one, just $80. As an example, B$ would have $42 (the ASCII code for B) in the first byte and $80 alone in the second byte. On the other hand, if the array name was BC$, the second byte would be the sum of the ASCII code for ($43) and the constant $80, making a total of $C3.

Bytes 3 and 4

These are address pointers to the next array arranged in the order low byte, high byte.

Byte 5

The number of dimensions in the array, obviously limited to 255.

Bytes 6 and 7

The array size, in high-byte, low byte order for a change. The three-byte string information blocks then follow on after the heading information.

Array name		Pointer to next array		Dimensions	Array size		
ASCII code	ASCII+$80 or $80	L byte	H byte	01	H byte	L byte	← Header
1	2	3	4	5	6	7	
Length	L byte	H byte	Length	L byte	H byte	Length	String information blocks
L byte	H byte	Length	L byte	H byte	Length	L byte	String information blocks

Figure 10.2 Handling string arrays

Program 10.1 Bubble sort of a string array

```
10 !BUBBLE SORT
20 !OF A STRING ARRAY
30 NUMBER      = $FB
40 COUNT       = $FD
50 ONE         = $57
60 TWO         = $59
70 FLAG        = $FF
80 STRING1     = $5B
90 STRING2     = $5D
100 LENGTH1    = $5F
110 LENGTH2    = $60
120 *=$C000
130                     SEC
140                     LDA NUMBER
150                     SBC #1
160                     STA NUMBER
170                     BCS LOOP1
180                     DEC NUMBER+1
190 LOOP1               CLC
200                     LDA $2F
210                     ADC #$0A
220                     STA TWO
230                     LDA $30
240                     ADC #0
250                     STA TWO+1
260                     LDA #0
270                     STA FLAG
280                     STA COUNT
290                     STA COUNT+1
300 LOOP2               LDA TWO+1
310                     STA ONE+1
320                     LDA TWO
330                     STA ONE
340                     CLC
350                     ADC #3
360                     STA TWO
370                     BCC SKIP
380                     INC TWO+1
390 SKIP                LDY #0
400                     LDA (ONE),Y
410                     STA LENGTH1
420                     LDA (TWO),Y
430                     STA LENGTH2
440                     INY
450                     LDA (ONE),Y
460                     STA STRING1
470                     LDA (TWO),Y
480                     STA STRING2
490                     INY
500                     LDA (ONE),Y
510                     STA STRING1+1
520                     LDA (TWO),Y
530                     STA STRING2+1
540                     LDY #0
550 LOOP3               LDA (STRING2),Y
560                     CMP (STRING1),Y
570                     BCC SWOP
580                     BNE NOSWOP
590                     INY
600                     CPY LENGTH1
610                     BEQ NOSWOP
620                     CPY LENGTH2
630                     BEQ SWOP
640                     BNE LOOP3
650 STAGE               BNE LOOP1
660 SWOP                LDY #2
670                     STY FLAG
680 LOOP4               LDA (ONE),Y
690                     TAX
700                     LDA (TWO),Y
710                     STA (ONE),Y
720                     TXA
730                     STA (TWO),Y
740                     DEY
750                     BPL LOOP4
760 NOSWOP              INC COUNT
770                     BNE SKIP2
780                     INC COUNT+1
790 SKIP2               LDA COUNT
800                     CMP NUMBER
810                     BNE LOOP2
820                     LDA COUNT+1
830                     CMP NUMBER+1
840                     BNE LOOP2
850                     LDA FLAG
860                     BEQ FLAGCLEAR
870                     LDA NUMBER
880                     SEC
890                     SBC #1
900                     STA NUMBER
910                     BCS SKIP3
920                     DEC NUMBER+1
930                     LDA NUMBER
940 SKIP3               BNE STAGE
950                     LDA NUMBER+1
960                     BNE STAGE
970 FLAGCLEAR           RTS

READY.
```

Program 10.2 Routine to test machine code

```
10 REM TESTING THE MACHINE CODE
20 REM STRING SORTING ROUTINE
30 PRINTCHR$(147):INPUT"ENTER NUMBER OF
STRINGS"
40 REM FILL AND DISPLAY ARRAY
50 DIM A$(B%)
60 FOR N=1 TO B%
70 B$=""
80 A%=10*RND(1)+1
90 FOR Z=1 TO A%
100 R%=26*RND(1)
110 K$=CHR$(R%+65)
120 B$=B$+K$
130 NEXT
140 A$(N)=B$
150 PRINT A$(N)
160 NEXT
170 PRINT:PRINT
180 PRINT"SORTING"
190 PRINT:PRINT
200 REM PREPARE CALL PARAMETER
210 HB%=B%/256
220 LB%=B%-(HB%*256)
230 REM PASS PARAMETER
240 POKE 251,LB%
250 POKE 252,HB%
260 TI$="000000"
270 REM CALL MACHINE CODE ROUTINE
280 SYS 49152
290 T%=TI/60+0.5
300 REM DISPLAY SORTED STRING ARRAY
310 FOR N=1 TO B%
320 PRINT A$(N)
330 NEXT
340 PRINT
350 PRINT B%"STRINGS SORTED IN"T%"SECONDS"

READY.
```

Program 10.1A Hex dump of Program 10.1

```
.
.: C000 38 A5 FB E9 01 85 FB B0
.: C008 02 C6 FC 18 A5 2F 69 0A
.: C010 85 59 A5 30 69 00 85 5A
.: C018 A9 00 85 FF 85 FD 85 FE
.: C020 A5 5A 85 58 A5 59 85 57
.: C028 18 69 03 85 59 90 02 E6
.: C030 5A A0 00 B1 57 85 5F B1
.: C038 59 85 60 C8 B1 57 85 5B
.: C040 B1 59 85 5D C8 B1 57 85
.: C048 5C B1 59 85 5E A0 00 B1
.: C050 5D D1 5B 90 0F D0 1E C8
.: C058 C4 5F F0 19 C4 60 F0 04
.: C060 D0 ED D0 A7 A0 02 84 FF
.: C068 B1 57 AA B1 59 91 57 8A
.: C070 91 59 88 10 F3 E6 FD D0
.: C078 02 E6 FE A5 FD C5 FB D0
.: C080 9F A5 FE C5 FC D0 99 A5
.: C088 FF F0 13 A5 FB 38 E9 01
.: C090 85 FB B0 04 C6 FC A5 FB
.: C098 D0 C8 A5 FC D0 C4 60 0E
.?
```

Armed with this information on the storage of string arrays, we can now turn to the study of Program 10.1.

Bubble sort string array

The homely, and sometimes despised, algorithm known as the bubble sort is again used. In BASIC it is horribly sluggish but in machine code it is quite acceptable and has the advantage of using little memory. Comparison with the integer version. Program 9.1, given in last month's issue, shows that they both have a good deal in common. Not every one will have an assembler for entering Program 10.1 directly because it is in source code so the equivalent machine code bytes (the object code) are given in the form of a hex dump shown as Program 10.1A.

To enter the machine code bytes, they can be POKEd individually, starting with the first byte at address 49152. However, remember that the Commodore 64 does not recognise hex bytes which means that you would have the boring task of converting them all to decimal first – and without making one single error! Fear not. Type in Program 10.3 which accepts data written in hex.

Once you have entered the code, you won't know whether you have entered everything correctly or, indeed, whether the program works at all. This is where Program 10.2 comes in handy. Assuming the machine code bytes are already in a block of memory starting at decimal address 49152, this program will call on the machine code and try everything out for you including the time the machine takes to execute the sort. You don't have to provide test strings because the program generates them randomly. Try it out with only a few strings to start with then double the number while noting how execution time increases rather steeply each time.

Understanding the source code

A flow diagram of the rather complex string comparison section of Program 10.1, is shown in Figure 10.3. Use it in conjunction with the following line by line treatment of the mechanism.

Lines 30 to 110 assign labels to all used locations. All locations used for storage are in page zero.
Lines 120 to 180 subtract 1 from the two-byte quantity stored in NUMBER and NUMBER +1.
Lines 190 to 250 collect the array space start address which is always stored in locations \$2F and \$30. An offset of \$0A is added in order to point to the first element of the array. This also skips the array zero element which may contain an array heading and thus will not need to be included in the sort. The result is placed temporarily in address pointer TWO (two bytes).
Lines 260 to 290 initialise the swop flag, FLAG (1 byte) and the loop counter, COUNT (two bytes) to zero.
Lines 300 to 330 copy the contents of pointer TWO to pointer ONE (two bytes each).
Lines 340 to 380 increment pointer TWO by adding 3, because it must point to the next string information block three locations away.
Lines 390 to 410 use indirect addressing to fetch the length of the first string from the string information block. This data is stored in pointer ONE.

Program 10.3 Poking a hex dump into memory

```
10  REM POKING A HEX DUMP INTO MEMORY
20  REM STARTING AT ADDRESS $C000
30  INPUT "HOW MANY BYTES IN HEX DUMP";N%
40  B=49152
50  FOR L=0 TO N%-1
60  READ D$
70  FD%=ASC(D$)-48
80  SD%=ASC(RIGHT$(D$,1))-48
90  IF FD%>9 THEN FD%=FD%-7
100 IF SD%>9 THEN SD%=SD%-7
110 BT%=16*FD%+SD%
120 POKE B+L,BT%
130 NEXT
140 DATA A9,00,85,FB,A9,05,85,FC
150 DATA A9,48,20,CA,F1,38,A5,FB
160 DATA E9,01,85,FB,B0,02,C6,FC
170 DATA A5,FB,D0,EC,A5,FC,D0,E8
180 DATA 60
```

Lines 420 to 430 do the same for the second string. The data is stored in pointer TWO.

Lines 440 to 530 obtain the start addresses of the string pair, again using indirect addressing. The addressing are stored in the page zero locations STRING1 and STRING2 (two bytes each).

Line 540 clears the Y register which doubles as the string character counter.

Lines 550 to 580 compare the ASCII codes of the string character pairs. The entire string descriptors are swapped over if they are in ascending order. Otherwise, they are left alone.

Line 590 increments the string character counter.

Lines 600 to 610 compare the length of the first string LENGTH1 to the character counter. If they are equal, no swap is required.

Lines 620 to 630 compare the second string length LENGTH2 to the character counter and, if equal, a swap is made.

Line 640 forces a branch back to LOOP3 ready for comparing the ASCII codes of the next pair of string characters. This cycle continues while neither of the above comparisons has resulted in a swap or a no swap branch.

Line 650 is an out-of-range branch patch. It is due to the limit on displacement imposed by relative addressing which would have been exceeded in line 960. This method is an alternative to using an absolute JUMP which would cause problems if the object code were to be relocated.

Line 660 stores 2 in the Y register. This acts as a byte counter and also as an index register for indirect indexed addressing.

Line 670 sets the swap flag. Any non-zero value stored in the location labelled FLAG indicates that a swap has taken place.

Lines 680 to 750 swap the 3-byte string descriptors, one byte at a time, using the X index register as a temporary intermediate storage location.

The remaining lines 760 to 970 are similar to lines 530 to 740 of the integer sort array given last month.

Using the routine

It is important to remember that, in use, the string array to be sorted must be the first DIMensioned in BASIC. This is because the start address, of the array to be sorted, is calculated from the start of the array space stored by the Commodore 64 in locations $2F (low byte) and $30 (high byte). If the above is not adhered to the sort routine will simply not work.

The final code is present in memory from $C000 (49152 decimal) onwards.

In order to use it all we need supply is the number of array elements to be included in the sort. For example, say that the total number of strings sorted in the array is placed in the variable B%. The following two lines of BASIC will split that number into a high byte and low byte component ready for POKEing into locations $FB and $FC (251 and 252 decimal):

```
10 HB%=B%/256
20 LB% =B%-(HB%*256)
```

The values are POKEd with the following two lines:

```
30 POKE 251,LB%
40 POKE 252,HB%
```

Finally, the routine is called from BASIC by: SYS 49152

Table 10.1 is a general guide to the sorting speed to be obtained for various random length strings. The table reveals that it takes approximately four times as long to sort double the number of strings.

Figure 10.3 Flow diagram of string comparison

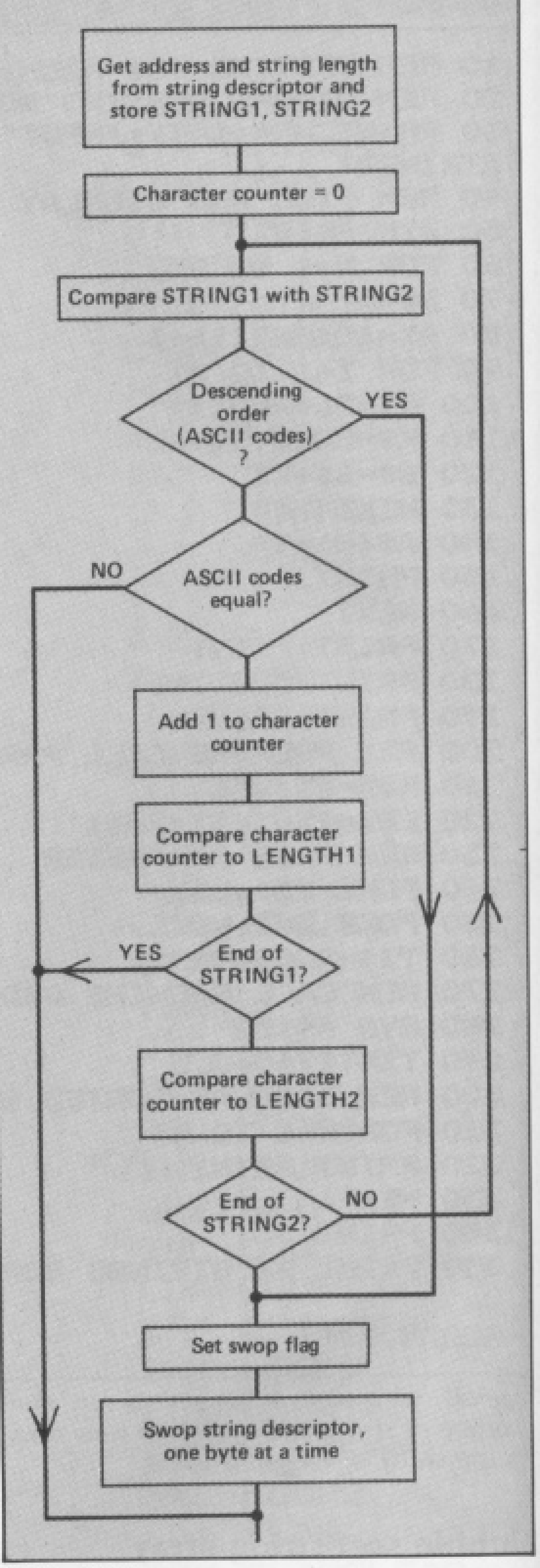
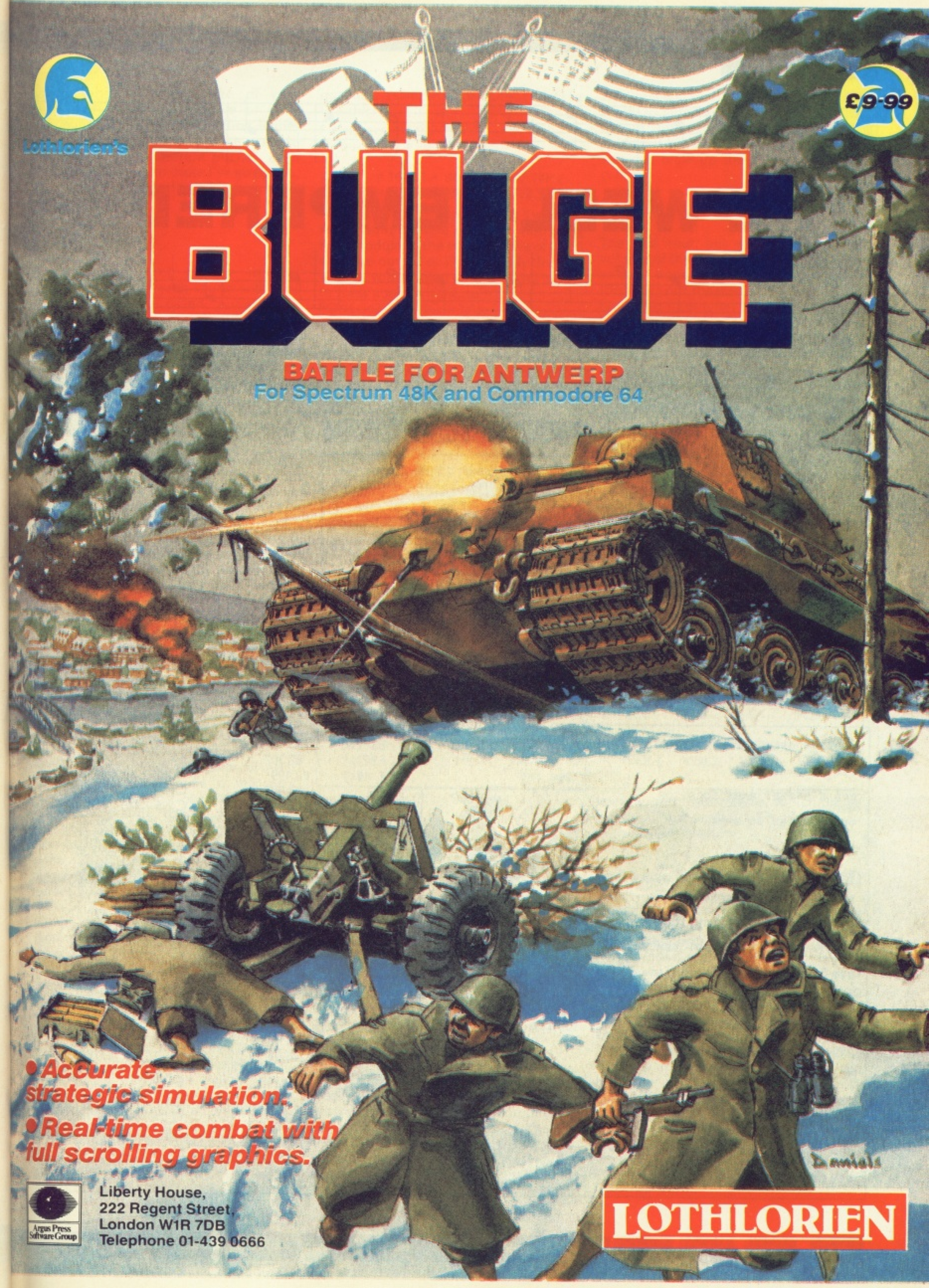


Table 10.1

No of random strings:	Typical sort time
100	1 sec
200	4 sec
300	8 sec
400	15 sec
500	23 sec
1000	95 sec

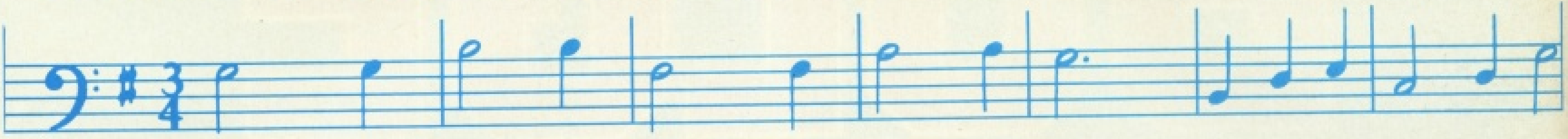
There are, of course, more efficient algorithms but few use less memory. For those interested in even faster methods using the 'diminishing increment sort' algorithm see our books 'Advanced machine code programming for the Commodore 64' or 'Filing systems and databases for the Commodore 64' published by Granada/Collins.



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SO FAR, WE HAVE COVERED computer music on the 64 in fairly general terms. Having filled in the coarse detail with a thick pencil, we can now pen in the fine detail that we missed! This time we'll be sampling such delights as synchronisation, ring modulation, more about waveforms, the ubiquitous oscillator 3, plus FREKK II, special effects and finally some tips on Imitative Synthesis. With the majority of you going "whaaat?", let us begin ...

Program Listing 1

```
100 REM ***PORTYMINTO BY FLIPPO***
150 REM
200 S=54272: BASE LOCATION
250 FOR I=S TO S+24
300 POKE I,0
325 NEXT: REM RESET SID
350 POKE S+5,0: POKE S+6,247: REM ADSR
400 POKE S+24,15: REM VOLUME
450 P=(17167-4291)/96: REM C4 TO C5
500 POKE S+4,17: REM TRIANGLE WAVE
550 FOR FQ=4291 TO 17167 STEP P
600 HF=INT(FQ/256)
650 LF=FQ-(256*HF)
700 POKE S+1,HF
750 POKE S,LF: REM ACTIVATE NOTE
800 NEXT
850 POKE S+4,16: REM TRIANGLE OFF
900 END
```

Only hertz when I type

Last month, I gave you a program, called FREKK, to type in to get the high byte and low byte values from a frequency in Hertz. Since I wrote that, I have been reliably informed that the fraction (derived from the speed of the 64's internal clock) I gave was based on the American standard which is wildly inaccurate. (Typical!) So, whereas I said ...

Program Listing 2

```
10 REM ***FREKK II BY FLIPPO***
20 REM
30 PRINT"[CLR]"
40 INPUT"FREQUENCY IN HERTZ ";HZ
50 IF HZ=-1 GOTO 999
60 FQ=INT(HZ/0.06097)
70 HF=INT(FQ/256)
80 LF=FQ-256*HF
90 PRINT"HF = ";HF
100 PRINT"LF = ";LF
110 PRINT"[CD]"
120 GOTO 10
999 END
```

F=INT(FQ/0.05961)

... it should have been 0.06097. This, I'm told is a much more accurate figure. In any case, FREKK needed a bit of tweaking up, so here is the elegant sequel, FREKK II.

So, that's how you get the HF and LF's, but where do you get the note frequencies in Hertz from? Right here! (Note: The number after each pitch denotes the octave). See Table 1.

The SID chip has a frequency range of between 0 and 4000Hz. (That's pretty

Pitch	Hertz(Hz)
C2	65.406
C 2	69.296
D2	73.416
D 2	77.728
E2	82.407
F2	87.307
F 2	92.499
G2	97.999
G 2	103.83
A2	110
A 2	116.54
B2	123.47
C3	130.81
C 3	138.59
D3	146.83
D 3	155.56
E3	164.81
F3	174.61
F 3	185
G3	196
G 3	207.65
A3	220
A 3	233.08
B3	246.94
C4	261.63
C 4	277.18
D4	293.66
D 4	311.13
E4	329.63
F4	349.23

Pitch	Hertz(Hz)
F 4	369.99
G4	392
G 4	415.3
A4	440
A 4	466.16
B4	493.88
C5	523.25
C 5	354.37
D5	587.33
D 5	622.25
E5	659.26
F5	698.46
F 5	739.99
G5	783.99
G 5	830.61
A5	880
A 5	932.33
B5	987.77
C6	1046.5
C 6	1108.7
D6	1174.7
D 6	1244.5
E6	1318.5
	F61396.9
F 6	1480
G6	1568
G 6	1661.2
A6	1760
A 6	1864.7
B6	1975.5

Table 1

good for a synth the size of your fingernail) making it capable of deep rumblings and very high tweetling, higher even than a piccolo can reach. Experiment with different pitches, even intermediate ones to those I've given you, to produce scales and tonalties more like Eastern music.

Special effects

A very important facility in the performance of a synth sound is that of *glide* (sometimes called *portamento*, goodness knows why!). This means when you play note the next note glides smoothly up to correct pitch rather than steps up to it. Let me demonstrate:
This program renders a gliding note from C in the 4th octave to C in the 5th octave.

Address	128	64	32	16	8	4	2	1
54276) 54283)- 54290)	Noise	pulse	saw	tri	test	ring mod	sync	

Table 2

It is done by incrementing the pitch by very small amounts, so the steps aren't audible. To hear the steps, just put in a delay:

775 FOR I=1 TO 100: NEXT.

... and now you can hear the stepping quite clearly. Glide is used to great effect in computer music, adding a touch of humanity (bendiness) to otherwise digital (steppy) sounds.

Now some difficult bits

Hidden deep within the heart of each oscillator on the SID lie a few very sophisticated controls. See Table 2.

Synchronisation, or sync, effects can give you some wonderful synth tones. One oscillator's waveform is modulated with another, the fundamental frequencies of the first being made to conform to the second's. This gives you some very rich harmonic blends, and although the pitch stays the same the harmonic content alters, giving you an enormous range of tone "colours". Sync for Osc 1 resides in address 54276 and to activate it you POKE 54276,1.

Ring modulation, or ring mod, is perhaps best known for being the effect on a Dalek's voice: fortunately it's uses in synthesis and music tend to be a little less disturbing! Ring mod is primarily used in the creation of realistic bell or gong tones; a ring modulator takes two frequencies and outputs a compound of the sum of the two frequencies (Huh?), and the difference between them. The result is a waveform whose harmonics are not related (they are normally), producing highly detailed metallic tonal qualities. A sample input/output might be like this:

Frequency 1 = 932.33Hz
Frequence 2 = 164.81Hz

Yields = 164.81 + 932.33 = 1097.14Hz
and = 932.33 - 164.81 = 767.52Hz

In order to use ring mod on Osc 1 we must select both *triangle* and *ring mod*; ring mod modulates the triangle wave of Osc 1 with the output of Osc 3. Really the best way for you to learn all about ring mod is to mess about with it, so try:
POKE 54276,18.(16+2=18!)

Give it a whirl and see what you can come up with.

Mostly, ring modulated waveforms contain all manner of unwanted harmonics which degrade the sound quality. To clean them up you need to filter the sound.

Filter tips

With trepidation in my heart, it is my solemn duty to lead you by the nose into yet *another* table, this time the registers governing the filter. See Table 3.

	128	64	32	16	8	4	2	1
54293	-	-	-	-	-	FC2	FC1	FC0
54294	FC10	FC9	FC8	FC7	FC6	FC5	FC4	FC3
54295	RES3	RT	XXXX					
54295	RES3	RES2	RES1	RES0	EXT.	OSC3	OSC2	OSC1
54196	3OFF	HP	BP	LP	VOL3	VOL2	VOL1	VOL0

Table 3

The registers hold as follows:

Filter cut-off: 54293 and 54294

Register 54293's last five bits (right to left, the dashes) aren't used. The remainder plus 54294 are the filter cut-off values, and as with previous registers, you can use them alone or added together (to get FC10 + FC8 = 128+32 = 160!). These bits don't control the cut-off point or the frequency of the filter; they are a reference point and the effect they cause is due entirely to the type of filter selected. (See Filter Type/Volume).

Resonance/Filter: 54295

Resonance affects the frequencies around the cut-off point, emphasising them and making them brighter. The first three bits (right to left) of this register govern which Oscillators go through the filter. The fourth bit is very interesting. This is the external input to the filter, whereby you can use the filter in the 64's synth to filter an external instrument's output! Interesting though it is, it really shouldn't be used without expert advice; you can blow up the chip if you're not careful!

Filter type/volume: 54296

The first four bits govern the overall volume of the system in a scale of sixteen values, from 0 (not a sausage) to 15 (blasting your speaker off). The next three bits select filter type: hi-pass, lo-pass and band pass. hi-pass lets high frequencies through, lo-pass lets low frequencies through and band pass lets frequencies at and either side of the cut-off point through and stops those further away. (There is actually another type of filter available if you add hi and band pass together – band reject or notch. This is the exact reverse of band pass, letting through all frequencies save the ones at the selected cut-off.) The last bit in this register is Osc 3 Off. Oscillator 3 can be very useful as a modulator for the other two, and in this case the output from 3 might be undesirable (noisy rubbish), so this gives us the option to toggle its output off.

The sophistication of the SID's filter is the one thing which sets the 64 head and shoulders above other micros, synthesis-wise. It gives you power over an enormous range of beautiful sonic textures and tone colours. Which brings me to our last section, with some tips on Imitative Synthesis.

Is it real, or is it . . . synthesised?

Imitative sythesis is the art (or in some cases science) of imitating natural sounds or conventional instruments. This is a controversial topic, as synths can imitate *any* instrument, with intelligent programming, and you try telling that to the Musicians Union; they'd smash your face in! Synthesisers, and Computer keyboards generally, are seen to be doing for the number of working musicians what the advent of computers did to the number of working accountants. Personally, I don't think musicians have anything to worry about: *nothing* sounds as good as a real instrument played well by a real person.

And, next month, I'll include some hints and tips on how to imitate all your favourite instruments.

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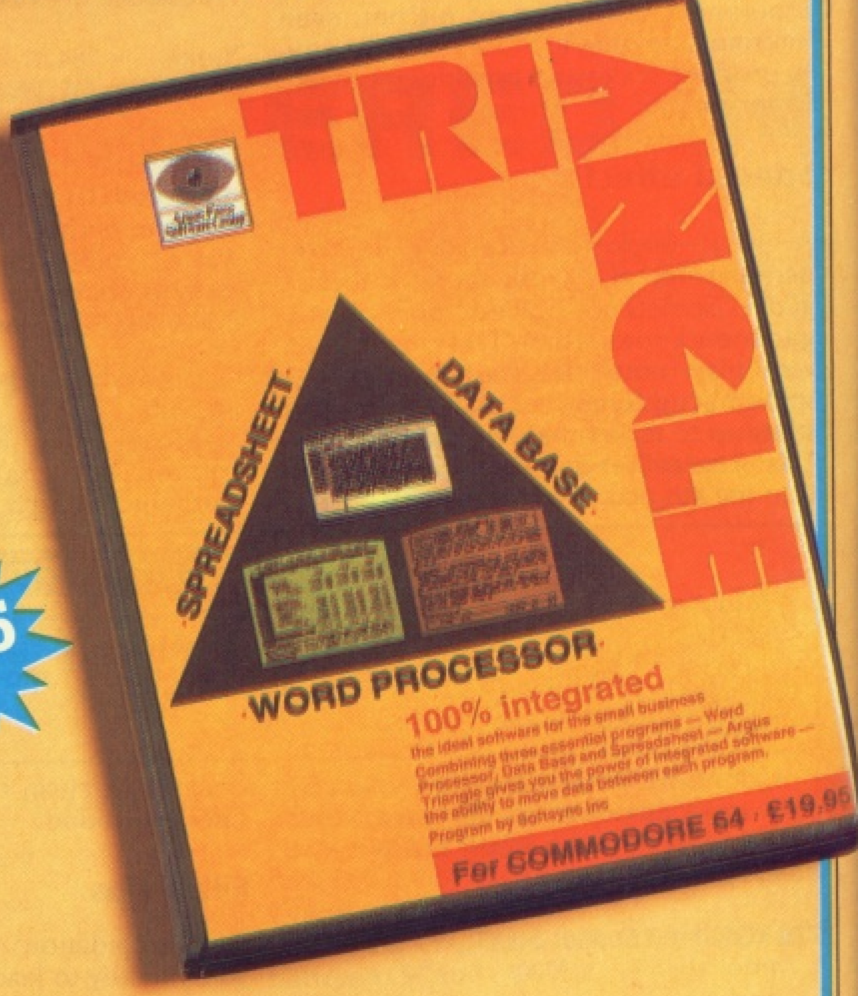
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AVAILABLE FOR COMMODORE 64 WITH DISC DRIVE

RELIABLE ROUTINES

Mike Hart explores one of the most frequently demanded programming routines: the ability to flash a message on the screen or to flash the whole, or part of the screen, on or off.

THE MOST COMMON USE OF flashing is that of prompting the operator to take some action by flashing a message several times on the screen.

In the little program called BASIC-FLASH, notice that A$ is initialised to a message in line 20 and a delay constant defined in line 30.

The main FLASH subroutine (1000-1050) prints the message, activates a delay loop, obliterates the message and activates a similar delay loop. If no key is pressed, the whole sub-routine is re-entered until any key press generates a RETURN. The crucial line is probably line 1020 which is merely a cursor up (CHR$(145)) followed by a blank line and terminated by another cursor up. This technique, or variations built around it, will work on any Commodore machine.

Commodore 64 owners might like to try the following 'one liner' which provides a quick and handy 'screen-shake'.

FOR J=0 TO 255 : POKE 53270,J: NEXT J

The following technique is usually used to flash the screen. First of all, get the character from the screen and then 'EXCLUSIVE-OR' it with $80 (128 decimal) – this 'flips' bit 7 from a 1 to a 0 or vice versa thus giving 'normal' or 'reversed' graphics. Then put the new character back into the same position. In earlier versions of the Commodore 64, the colour must also be POKEd back to the screen.

Either the whole screen, or just particular sections of it, can be reversed. With 1000+ POKEs to the screen and the colour memory map, this would take an eternity in BASIC.

The machine code routine, REVERSE-FLASHER, overcomes the long wait. If the subroutine is called once only, then a certain portion of the screen is reversed: if a delay loop is built in and the process repeated several times, you can get the flashing effect you desire.

Your first task in REVERSE-FLASHER is to decide where to locate the code – I have placed it in the cassette buffer out of force of habit but it can go into safe location. $C000 (49152) is a good place if not occupied by anything else and if you make variable LN (LOCATION) in line 10 the starting point of your code.

Next, three parameters are provided: INK (the character colour); PAPER (the background colour) and the number of lines (starting from the top of the screen). The demo is set up so that INK is black, PAPER is grey 2 and the number of lines is set to 10. To flash the whole screen the number of lines would be 25.

The routine saves the current character colour and background colour and then restores them after the flash. The 'nest' flashing effect is obtained if the initial paper colour is maintained throughout: this is because, if you change the PAPER colour, the whole screen is changed to that colour whilst the first n lines will flash. The delay loop may be shortened or lengthened or even cut out altogether. The length of the whole flash can also be controlled in a similar fashion by altering the end value of the J loop in line 80.

It is best to experiment with this routine until you find an effect which suits you best.

Finally, a machine-code disassembly is provided for those readers who like to study such things to see how they work and also improve them if necessary.

Happy flashing!

Program Listing

```
1 REM *** REVERSE..FLASHER ***
2 :
3 REM  **     MIKE HART      **
4 :
5 REM SYNTAX:SYS(LOC'N) INK,PAPER,LINES
6 :
10 LN=828:INK=0:PAPER=12:LINES=10
15 :
20 FOR J=0 TO 87: READ X
30 T=T+X:POKE LN+J,X:NEXT
40 READ CH: IF CH=T THEN 60
50 PRINT"DATA ERROR!":END
60 PRINT:PRINT"O.K."
65 :
70 REM *** DEMO ONLY ***
75 :
80 FOR J=1 TO 50:SYS(LN)INK,PAPER,LINES
90 FOR DL=1 TO 25:NEXT DL:NEXT J
95 :
100 DATA 173,33,208,133,253,173,134,2
101 DATA 133,254,32,235,183,142,33,208
102 DATA 32,241,183,138,72,165,20,162
103 DATA 0,157,0,216,157,0,217,157
104 DATA 0,218,157,0,219,202,208,241
105 DATA 104,170,169,0,133,251,169,4
106 DATA 133,252,160,39,177,251,73,128
107 DATA 145,251,136,16,247,202,240,13
108 DATA 24,169,40,101,251,133,251,144
109 DATA 233,230,252,176,229,165,253,141
110 DATA 33,208,165,254,141,134,2,96
111 DATA 12779
READY.
```

```
READY.


B*
   PC  SR AC XR YR SP
.;0008 B0 A3 A3 FF F6
.
033C AD 21 D0     LDA $D021
033F 85 FD        STA $FD
0341 AD 86 02     LDA $0286
0344 85 FE        STA $FE
0346 20 EB B7     JSR $B7EB
0349 8E 21 D0     STX $D021
034C 20 F1 B7     JSR $B7F1
034F 8A           TXA
0350 48           PHA
0351 A5 14        LDA $14
0353 A2 00        LDX #$00
0355 9D 00 D8     STA $D800,X
0358 9D 00 D9     STA $D900,X
035B 9D 00 DA     STA $DA00,X
035E 9D 00 DB     STA $DB00,X
0361 CA           DEX
0362 D0 F1        BNE $0355
0364 68           PLA
0365 AA           TAX
0366 A9 00        LDA #$00
0368 85 FB        STA $FB
036A A9 04        LDA #$04
036C 85 FC        STA $FC
036E A0 27        LDY #$27
0370 B1 FB        LDA ($FB),Y
0372 49 80        EOR #$80
0374 91 FB        STA ($FB),Y
0376 88           DEY
0377 10 F7        BPL $0370
0379 CA           DEX
037A F0 0D        BEQ $0389
037C 18           CLC
037D A9 28        LDA #$28
037F 65 FB        ADC $FB
0381 85 FB        STA $FB
0383 90 E9        BCC $036E
0385 E6 FC        INC $FC
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